

case study

21st Century 3D

21st Century 3D Increases Stereoscopic Camera Shooting Time With Momentus 7200.1

Company

21st Century 3D

Location

New York, N.Y.

Contact

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Primary Focus

Stereoscopic 3D motion picture production company; leader in 3D content creation and developer of 3D technologies; creator of award-winning 3D productions for Fortune 500 companies worldwide

“With Momentus 7200.1 drives, the new 3DVX3 camera has already begun to substantially expand the potential for HD stereoscopic films.”

—Jason Goodman, inventor of the 3D Stereoscopic Camera

The first 7,200-RPM, 2.5-inch notebook hard drive that 21st Century 3D tried in its new 3DVX3 stereoscopic camera worked fine for the first 40GB to 50GB, then slowed down to the point that the camera became unusable. So 21st Century 3D switched to the Seagate® Momentus 7200.1 drive, which keeps up with the camera's high data rate over the drive's full 100GB capacity.

Until recently, anyone wanting to shoot stereoscopic video had limited options—there were cameras used to shoot Imax theatre films, which are too expensive and bulky for corporate or low-budget commercial productions, and the much less expensive and smaller stereoscopic devices made by combining two commercial cameras that produce video of considerably lower quality.

21st Century 3D, a motion picture production company headquartered in New York City, recognized the potential for dramatically increasing the stereoscopic market if it could somehow substantially reduce the cost of producing high-definition (HD) video. The company recognized that the only way to produce an economical camera was to use inexpensive commercial video cameras produced in large quantities. But they had to overcome the substantial reduction in image quality produced by the cameras' data compression algorithms.

Advances in Stereoscopic Cameras

21st Century 3D uses two Panasonic AG-DVX100A cameras in its new 3DVX3 camera. Off the shelf AG-DVX100A cameras substantially compress the image, reducing both resolution and color space, in order to comply with the data transfer and storage limitations

imposed by the miniDV format. 21st Century 3D overcame these limitations by bypassing the miniDV and, instead, taking data directly from the camera's analog to digital converters over USB 2.0.

The two cameras are genlocked (synchronized), and the uncompressed images are simultaneously captured by two onboard Apple Mac Mini computers running Mac OS X with over 2.8 GHz of processing power, 2GB of RAM, and 8GB of flash memory. The company's compact, 22-inch-long new 3DVX3 camera captures raw CCD data in 4:4:4 RGB color space at 10 bits per channel, producing remarkably vivid HD 3D images at up to 1280x720 per eye and 24 fps. Since no color decimation or spatial compression is applied to any of the color channels, the 3DVX3 greatly exceeds the image quality of the original camera, as well as other consumer high-definition cameras and the stereoscopic devices that are built from them.

“The key to the performance of our camera is its ability to capture uncompressed images directly from the analog to digital converter of the AG-DVX100A cameras,” said Jason Goodman, inventor of the 3DVX3 stereoscopic camera. “The use of uncompressed images eliminates artifacts and data loss and provides the opportunity to deliver the largest possible color space.”

The Need to Capture at 29 Mbytes/sec

"But uncompressed images generate an enormous amount of data, approximately 29 Mbytes per second per channel, compared to 3 Mbytes for the off-the-shelf camera," Goodman said. "In designing the 3DVX3 camera, we needed a way to store all of that data quickly enough to avoid filling up the Mac Mini's buffers. We also needed to store enough data to avoid interrupting the shoot frequently to change storage media. Finally the storage device needed to be small and light so the stereoscopic camera can go places that conventional 3D systems cannot, such as car mounts, Steadicam stabilizers and handheld operation."

Using an array of hard drives would increase storage capacity and performance but would add substantially to the weight, power consumption and cost of the camera. So Goodman decided to use two, 2.5-inch notebook hard drives, one connected to each CPU. At the time 21st Century 3D was designing the device, the highest-capacity 7200-RPM, 2.5-inch drives were available only from a Seagate competitor. The drives had a capacity limit of 60GB, not as high as the 3DVX3's designers would have liked but an amount that seemed sufficient. The drive also needed to be able to keep up with each camera's speedy data rate. 21st Century 3D purchased a few of the drives and tried them out. They worked well—up to a point.

Other Drives Can't Handle the Data Rate

"The first drives we tried had no difficulty keeping up with the camera until they contained about 40GB+ of data," Goodman said. "At that point the rate at which they were capable of accepting data slowed to the point that the buffers filled up and the camera stopped recording. We tested them a number of times and found that they consistently maintained this same level of performance. They were usable only up to about 40GB to 50GB capacity."

What caused this problem with the competitor's drives? With the drive moving at a constant number of revolutions per minute, the speed at which the surface of the outer tracks of the drive moves across the head is much faster than the inner tracks. This means that the drive is capable of reading or writing data at a faster rate on the

outer tracks. Hard drives fill the outermost tracks first and then progressively fill the rest of the drive moving towards the center. By the time the heads had moved two-thirds of the way towards the center of the competitor's drive, the drive's data rate had slowed to the point that it could no longer keep up with the cameras.

Then Goodman heard about the Seagate Momentus 7200.1 2.5-inch, 100GB drive, which had just come on the market. Momentus 7200.1 offers a sustained internal transfer rate of 45.5 Mbytes/sec and a maximum external transfer rate of 150 Mbytes/sec, with a Serial ATA interface combined with native command queuing (NCQ).

Conclusion

"We bought a couple of the drives and installed them on our camera," Goodman said. "The Seagate Momentus 7200.1 drives were able to handle the data produced by the camera without any difficulty up to their full capacity of 100GB. This increased the capacity of our camera by nearly 2.5 times, from under 50GB to 100GB. Furthermore, the Seagate drives draw only 0.58 amps during shooting compared to 1.1 amps for the other drives, making it possible for the camera to run for over two hours on a Dionic 160 lithium ion battery."

The performance of the Momentus 7200.1 notebook drives on this application showcases their position as the highest-performing notebook drives on the market. These 7200-RPM drives offer the same performance as high-end desktop drives. Yet they also provide 800 Gs of nonoperating shock tolerance, 250 Gs of operating shock tolerance, and low power consumption, which makes them ideal for workstation-class notebook PCs.

"With Momentus 7200.1 drives, the new 3DVX3 camera has already begun to substantially expand the potential for HD stereoscopic films," Goodman concluded. "We have used the new camera to produce stereo video for corporate clients for trade shows, product launches and special events. These videos are presented in theatres and ballrooms on large screens with the audience wearing polarized 3D glasses. We have also been in discussions with Hollywood filmmakers on using this technology to bring IMAX film quality into neighborhood theaters."

To Learn More:

21st Century 3D

Visit the company's Web site at www.21stcentury3d.com.

Seagate Momentus Drives

The Seagate Momentus hard drive family combines low power consumption and high shock tolerance with a range of spin speeds—7200-, 5400- and 4200-RPM—to meet the needs of a variety of applications. Available in capacities of up to 160GB, the 2.5-inch Momentus drives are ideal for mainstream and high-performance notebook and laptop PCs. The drives are also a good fit in non-PC applications, such as MP3 players, external storage (USB), copiers/printers and entry-level blade servers. To learn more about Seagate Momentus drives, go to seagate.com/products/notebook/.