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On the cover:

The Telehandler integrated hydraulic system from Sauer Danfoss used in a fork lift.



2005 World Expo Facts	
Theme	Nature's Wisdom
Site	Aichi, Japan
Closing date	September 25
Projected number of visitors	more than 15 million

By Len Vermillion, Managing Editor

Q&A: Displaying New Types of 'Realities'



For 182 days this summer, the 2005 World Expo in Aichi, Japan has featured food, entertainment, and emerging technologies from around the globe. One of the attractions wooing visitors is called Nature Contact, an interactive ride that lets visitors view virtual endangered species via microdisplay technology. Dr. Hong Choi is Kopin Corp.'s chief technology officer and was intimately involved in the creation of the World Expo exhibit.

Taunton, MA-based Kopin joined forces with video eyewear maker Icuti Corp. of Rochester, NY, Ray Corp. of Tokyo, and Hitachi to create the technology behind the ride. Visitors see the animals through an AdventureScope, a binocular viewer that shows life-like computer-generated 3D images of the animals that react to viewers' hand movements.

One of the important parts of the AdventureScope technology is a microdisplay provided by Kopin. The unit features Kopin's custom color version of its 0.97-inch-diagonal, 1,280 x 1,024-resolution CyberDisplay 1280M. It also uses Ray Corp.'s interactive software, which provides motion tracking and graphics that bring the mixed-reality system to life. It uses the same animation technology that the movie industry uses for movies such as "Jurassic Park" and "The Matrix," but in real time and in 3D so that Expo visitors are immersed in the realistic experience.

According to Dr. Choi, the Nature Contact exhibit demonstrates the immense abilities of microdisplays. It shows how they can be used to create the same vivid high-resolution images that large screen displays can. He should know: he has a long history with microdisplays and worked for 17 years at MIT's Lincoln Laboratory. He also holds a Ph.D. in electrical engineering from the University of California, Berkeley. In the following interview, Dr. Choi explains the outlook for microdisplays and how they helped bring the animals to life.

Len Vermillion: What is the nature, pardon the pun, of Kopin's involvement with AdventureScope?

Dr. Hong Choi: Kopin developed a new high-resolution microdisplay as part of an unprecedented entertainment experience called Nature Contact, an interactive mixed-reality ride that lets visitors interact with virtual manifestations of some of the world's most endangered animals. It debuted in April at Hitachi's Pavilion at the 2005 World Exposition, which is one of the most popular sites with about 100,000 visitors per day. Kopin worked with Icuti in Rochester, NY, which developed the personal video headset, and Ray Corp. of Tokyo, which combined the headset with its own 3D graphics and animation software to create the AdventureScope virtual reality viewing system.

LV: How does AdventureScope get its realism?

HC: The 3D virtual reality effect is achieved using a binocular viewer. The AdventureScope headset incorporates two Kopin microdisplays, giving each eye a slightly different image, in much the same way 3D movie glasses work. The brain takes the video and image information from each eye and unites them into one view, interpreting the slight differences between each view as depth. This produces a 3D stereoscopic vision of the animals

and surroundings, enabling users to see exactly where the images are in relation to their own bodies. The unique software provides motion tracking and graphics that bring the mixed-reality system to life.

LV: Icuti needed an ultra-high-resolution display that could fit into the compact binoculars. How did Kopin's microdisplay — the CyberDisplay 1280M — fit the bill?

HC: The application required very high-resolution color displays to achieve the necessary realism. But Kopin had not developed high-resolution color microdisplays beyond VGA levels at that time. We were also under a tough time constraint to meet the customer's deadline. So we took our existing 1280M monochrome CyberDisplay with 1280 pixel elements and applied color filters to it. The 1280M is slightly smaller than one inch — 0.97 inches to be precise — and draws just 85 mW of power, which fit well within the AdventureScope's requirements.

LV: How difficult was it to meet such exacting specifications?

HC: While the 1280M is a tiny display, it is somewhat large by Kopin standards. We have developed color microdisplays as small as 0.16 inches. The biggest concerns were in achieving good-quality image with high contrast and uniformity as well as in meeting the image matching requirements for each eye, since both microdisplays should present very similar quality images in order to have the natural 3D feeling.

LV: I imagine future applications will involve ever-increasing optical challenges. How important a role will microdisplays play in solving these challenges?

HC: There's a growing need for better image quality and higher resolution in mobile video applications, driven by the current push to bring TV and movies to cell phones and handhelds, as well as the portable gaming platforms like Sony's PlayStation Portable. Watching video on these devices' small, low-resolution screen remains the biggest inhibitor to mass consumer adoption, many people believe. Microdisplays embedded in stylish video eyewear holds the greatest potential to bring a big, theatre-quality viewing experience to these small devices. In addition, 3D gaming could be a killer application for video eyewear since the 3D effect can be best realized with eyewear with two microdisplays.

LV: Since the World Expo is all about future technologies, how do you see microdisplays evolving?

HC: We believe the industry will continue to see breakthroughs in ever-increasing resolutions and ever-smaller form factors with clever designs. We have now developed a prototype SXGA display with 1280 x 1024 color resolu-

More Than Just an Amusement Ride

Microdisplay technology has come a long way in recent years. The Nature Contact ride at the 2005 World Expo is more than just an entertainment experience; it's a demonstration of the abilities of modern microdisplays, according to Dr. John C. C. Fan, president and CEO of Kopin Corp.

"The project demonstrates [our] unique ability to design and manufacture displays to exacting specifications and solve complex optical challenges," he says. "The Kopin CyberDisplays used in the AdventureScope binoculars are the most advanced microdisplays in the world, although they are not commercially available product. This Nature Contact project is important because it demonstrates the ability of microdisplays to create the same vivid high-resolution images that large-screen displays can — only now in a compact mobile and very realistic 3D format. Our partners and I experienced this exciting ride, and it significantly raises the entertainment bar, perhaps even above the IMAX experience. Millions of visitors are expected to enjoy Nature Contact, and it is truly rewarding to see our efforts become a reality. We believe that this will be a creative springboard for the next generation of commercially available eyewear for a variety of mobile entertainment."

tion, which is better than high-definition TV. With 3932 pixel elements, it has three times more pixels than the one used in the AdventureScope, but in the same size form factor. This display is currently developed to support U.S. Army's advanced soldier systems such as the Digital Enhanced Night Vision Goggle, Objective Force Warrior, and Future Force Warrior. However, it has a huge potential in ultra-high-resolution virtual reality applications for industrial design and simulation. We will also see ruggedized versions of our microdisplays used in some of the world's toughest environments including military avionics systems, soldier systems, location-based entertainment systems, automotive and motorcycle heads-up display systems, and equipment for the outdoor enthusiast. Kopin's microdisplays are already bringing night vision and IR imaging capabilities to the U.S. military. Other future applications include doctors using microdisplays to perform less invasive micro-surgery, mechanics and mechanical engineers using head-mounted displays for hard-to-reach machine diagnostics, and firefighters using microdisplay-enabled helmets to see through smoke and darkness, to name just a few.

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