



CAMERAS POWERED BY JAVA™ TECHNOLOGY

The Next Best Thing To Being There

With an infrastructure steeped in Java™ technology, Perceptual Robotics, Inc. is using webcams to help companies develop e-commerce strategies, manage logistics and operations, even webcast special events. These cameras feature web-based control of telerobotic cameras (including pan, tilt, and zoom), high-quality, and industry standard still JPEG photographs of remote locations. And they require no additional software or plug-ins on the client side -- a simple browser is all that's required to begin exploring.

by [Steven Meloan](#)

October 15, 1999 -- During the last several years, webcams have spread across the Internet like wildfire. But the enticing, live snapshot devices have often run a narrow gamut of usefulness -- from the mundane, to the sometimes absurd. Some say that the concept began in 1991 when a group of researchers at Cambridge University installed a camera directed at their shared coffee pot. After all, why leave the comfort of your cubicle just to find out whether the latest pot is hot and steaming? And then the Internet lookee-loos began to arrive, wanting to take a peek as well -- because they could.

But now, with an infrastructure steeped in Java™ technology, Perceptual Robotics, Inc. has single-handedly catapulted the webcam concept into the big time -- serving such diverse real-world needs as e-commerce, logistics and operations management, webcasting of special events, and product/brand marketing. With a unique and intuitive "click-in-picture" interface, PRI offers Web-based control of telerobotic cameras (including pan, tilt, and zoom), providing high-quality, and industry standard still JPEG photographs of remote locations. And best of all, the technology requires no additional software or plug-ins on the client side. A simple Web browser is all that's required to begin exploring.

The Vision Thing

"Our CEO, Paul Cooper, first had the idea for what he called 'Ubiquitous Vision'," explains Dave Abrams, Director of Technology for PRI. "That's the concept of giving people the ability to see whatever they want, wherever they want, and anytime they want." Cooper's original vision, along with that of co-founder Peter Prokopowicz, was eventually refined into PRI's flagship product, known as "Telepresence" technology. Telepresence not only provides for a simple to use interface -- allowing for pan, tilt, zoom, size, and even resolution selection on a variety of camera types -- but also facilitates multiple users via a unique time-sharing technology.

"That's the magic of our technology," explains Abrams. We can send a person a 24 bit, 640x480 color image. And while that image is downloading, the camera is spinning off somewhere else, grabbing pictures for other people. It time-shares the control of the hardware among multiple users, and gives each person the sense that they're the only one in control."

In business for only three years now, PRI is already providing its telerobotic services to such high-end customers as Mercedes Benz, Boeing, Ford, MSNBC, Hewlett Packard, Harley Davidson, The Hard Rock Hotel, House of Blues, E! Online, the EPA, the U.S. Army, and more.

In the Beginning

Some businesses have come to explore Java technology in order to address specific technical challenges and needs. But Perceptual Robotics has relied upon Java technology from its very inception. "We pretty much bet the company on it," confirms Abrams. "Paul, Pete, and I, the first three in the company, had all used Eiffel, Sather, and Smalltalk back in our academic days. Those are all object oriented languages. But when the Java platform came out, and we looked at the language and saw how Sun was supporting it, we knew it was the way we wanted to go."



A telerobotic shot of Hurricane Floyd.

PRI's telerobotic systems began with a CGI-based architecture on the server, with a core piece of Java technology -- a multi-threaded server application that talked to the C-based device drivers controlling the cameras. But this relatively simple early architecture has since blossomed to encompass the full scale of Java technology -- including applets, servlets, JDBC™, JavaServer Pages™ technologies, and near-future plans to include Jini™ technology.

"Our current system has two basic components," explains Abrams. "One is the encoding component, for the camera controller. That's an on-site PC, running either Windows NT, Solaris™, or Linux operating environments. Its code is written 90% in the Java programming language, and about 10% C, for the device drivers. It's the camera appliance resource manager -- a multi-threaded Java technology-based application, with a mini Web server built into it. It handles multiple requests, and different configurations of hardware."

Beneath the camera appliance layer is the primary server for PRI's technology, powered by Java technology-based servlets running on the Solaris platform, using Sun's Java Web Server™ software. "We started writing our servlet about a year and a half ago," says Abrams, "right when the spec first came out."

The use of Java technology-based servlets in such enterprise applications is becoming ever more widespread. "It's really great to see exciting new technologies like Perceptual Robotics realizing the many benefits inherent in Java technology, and specifically in servlets," says Michaela Gubbels, Sr. Product Manager for Sun's JavaServer Pages/Servlets Technology group. "There's no substitute for real world rapid deployment, groundbreaking performance gains, and easy extensibility. Their experience speaks volumes about the reasons why we're seeing widespread adoption of this technology."

The move to servlets has brought several major pluses to PRI's Telepresence technology. "First of all," says Abrams, "using Java technology enables you to quickly develop stable software. We built a very sophisticated system that has lots of synchronization, lots of threading, and lots of management of multiple connections."

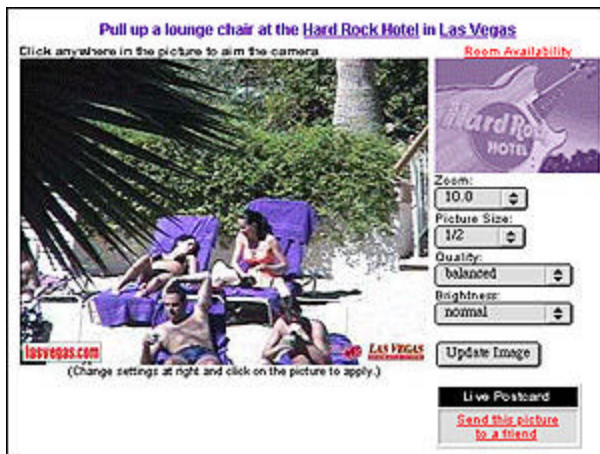
A servlet architecture also stands head and shoulders above PRI's early CGI configurations. "In the old days," says Abrams, "we were spawning a 1 MB process for each user who came onto a camera. As you can imagine, that can get pretty out of hand. Now, each new user is just another thread in the servlet."

And the end results of this more mature infrastructure pretty much speak for themselves. "We've served up the NBA Finals, and the U.S. Tennis Open," boasts Abrams, "and lots of other major news and media events."

Zooming In

A single camera powered with PRI's Telepresence technology is capable of snapping a picture every second. But there are several ways to increase these numbers even further. One method is by combining multiple cameras into a single "super camera." At the 1999 NBA Finals, groups of four robotic cameras were combined into a single point of view, appearing as one camera to the viewers. "At some of our major sporting events," says Fran Greenman, Director of Marketing for PRI, "we've delivered multiple requests every second."

And such high-volume loads are even further facilitated by PRI's innovative caching technology. As traffic increases, a sophisticated caching algorithm identifies similar user requests, re-using pictures taken just seconds earlier. "If you have 10,000 people viewing an event," explains Greenman, "groups of them are bound to be looking in the same area. The software is smart enough to recognize that, and to give them the same picture."



PRI technology by the poolside.

Servlets and More

PRI's Telepresence technology now goes well beyond mere Java technology-based servlets. "We also have software written in the Java language that will stitch multiple shots together into a panorama, in real time," explains Abrams. The tool provides a GUI that lets the user determine the size and position of the pan. "You can visually drag out the area of the pan that you want, along with the file size," he says. "And you can even set it up to be taken on a particular schedule."

Such panoramic files can then be viewed using PRI's unique panorama applet written in the Java programming language. "It actually looks very similar to QuickTime VR," explains Abrams. "The applet acts as a viewport into one of these panoramas, letting you interactively navigate through what amounts to a very large JPEG."

Another of PRI's applets lets viewers interactively direct the viewpoint, offering digital effects, such as zooms, prior to the actual optical effect being requested and downloaded. "The applet lets you steer," says Abrams, "and then digitally zoom in while you're exploring. It's a little like playing a video game."

Another recent technology in PRI's bag of tricks is their Java technology-based picture scanner tool. "Say you want to take a series of pictures to monitor an assembly line," says Abrams. "With this utility, you can build an automated archiving application to do that on top of our technology."

Meanwhile, a Java technology-based log analysis tool provides overall system and user data. "It tells you the responsiveness you're getting from the server software," says Abrams, "as well as the type of responses, and the number of user requests."

And more recently, PRI has deployed its cutting-edge "Live Card" servlet. With this, a viewer can email an image which contains a link directly back into the Telepresence space that originally generated the shot -- allowing the recipient to seamlessly continue exploring on their own. "Say I'm looking at a couch in an e-commerce furniture warehouse," explains Abrams, "and I want to send it to my wife and ask whether we should buy it. She can see the original shot, and then simply click on the image and go exploring herself -- zooming in on the fabric, the specifications, the price tag, etc."

PRI has nothing but high marks for the many benefits that have come from a broad-based Java technology solution. "As I mentioned," says Abrams, when we started out, we pretty much bet the company on Java technology. It's possible that we wouldn't even exist today if we hadn't made that choice. It let us build a very complicated, multi-threaded piece of technology, reliably and quickly. And that allowed us to get ahead, and to stay ahead, of the market. Keep in mind," he adds, "we're now at version 4.0 of our technology. But we built the early versions with basically just the three people who founded the company."

The Real World

PRI now offers a fully integrated hardware, software, and service package. This includes everything necessary to put the interactive camera system on the Internet -- PRI's Telepresence software, integrated video subsystem, server computer, and systems integration. Just plug it into the Internet, and you're ready to go!

And the customers keep coming...

This past July, baseball fans from around the world were able to experience the 70th Major League Baseball All-Star Game held at Boston's Fenway Park -- courtesy of PRI's telerobotic "Diamond Cam" located behind home plate.

And Chicago's Field Museum offers amateur Paleontologists front-row seats to the ongoing preservation work being done on "Sue," the worlds largest and most complete Tyrannosaurus rex fossil specimen.

Meanwhile, a bank of 9 robotic PRI cameras offered basketball fans front-row seats to the 1998 NBA finals -- including pre-game warm-up, on-court action, panoramic vistas, and even celeb hunting in the VIP section!

And the list goes on... from the U.S. Open Tennis Championship, to the premieres of "Godzilla" and "The X-Files," to the Cannes Film Festival, to shows at The House of Blues, to U2's "Pop Mart" tour. Seemingly no event is immune to the allure or the reach of PRI's Telepresence cameras.

Down To Business

With PRI's telerobotic cameras strategically placed in physical retail locations and product showrooms, shoppers can now look for real items in real stores, from the comfort of the desktops. "The 'Look and Buy' package is a market-targeted refinement of our core technology, that integrates with an e-commerce engine," explains Greenman. "It lets a business leverage the investment in their brick-and-mortar store, the look and feel and design of it -- which they may have spent their entire careers working on -- and bring that



PRI technology being used at a Hollywood premiere.



Zooming in and out helps consumers in e-commerce transactions.

PRI's Look and Buy package offers numerous features for store navigation and product inspection (through maps, thumbnail images, and slide shows), along with tools to integrate with various e-commerce systems. Houston's Gallery Furniture, one of the most successful furniture superstores in the country (with 95,000 square feet of showroom space), already boasts an array of 48 PRI cameras targeting their wares.

"Gallery Furniture has tags on each furniture item," explains Abrams. "The tag contains an SKU number, and when you type that into the browser, it jumps you to an e-commerce engine in order to purchase the item." And more sophisticated e-commerce schemes are already in the works. "The software knows where the camera is looking," Abrams says, "so if you're pointing at a painting on the wall, we can pre-author a "buy" button relevant to that hotspot." And the reverse concept is also possible -- letting a customer enter a particular item number, and then having the e-commerce engine take them directly to the camera displaying that item.

In addition to the exploding e-commerce market, PRI is also diving head first into Enterprise Monitoring. "One of our customers is Boeing," says Abrams. "They use our systems for manufacturing plants and supply chain management. People at all levels of an operation can verify the status of the project at a particular time and date. You don't have to fly someone out to a site to get a status update. You just take them to the cameras!"

And this same functionality is being used for EPA cleanups, as well as by a large shipping company to monitor its various ports. "In some instances," adds Abrams, "you might even want to use our cameras simply as a goodwill gesture for customers. In the case of Boeing, you could set up cameras and let the customer literally watch their plane being built!"

PRI's telerobotic cameras are also ideally suited to Web-based product and brand marketing -- getting your name and your presence out there with the eye-popping appeal of a live interactive camera. Jumping on this marketing bandwagon are such high-profile venues as The Hard Rock Hotel in Las Vegas (with their "wish-you-were-here," pool-side bikini-cam), and Universal Studio's City Walk, in Orlando, Florida.



The EPA zooms in for a better view.

The business applications for PRI's Telepresence technology are seemingly endless. Already, they have installed systems in corporate daycare centers -- allowing harried office workers (with secure password protection) to zoom in on their little ones from the comfort of their desktop. "We're currently in negotiation with a nation-wide daycare provider to do the same," says Greenman. And the concept is catching on in other venues, as well. "We're also negotiating with several hospitals," she adds, "to put cameras in their neonatal nurseries, so the family and the friends of newborns can see them right there in the nursery."

Labor Day weekend, PRI's home page even offered a timely "Hurricane Floyd Cam," live, from the New Jersey shore -- offering a Web-controllable view from where no human dared tread.

Focused on the Future

Never slouching in the development department, PRI has a constant eye toward the future. "We're using the JDBC API for our new photo-album software," says Abrams. "It will include JDBC technology, servlets, and an SQL database, and will let users create their own albums of favorite shots from our cams. It should be available on our Website within the next week or two."

PRI's industrial monitoring facility is also reaching ever-greater states of maturity and functionality. "Our industrial monitoring customers are just beginning to use our Scheduled Shot Image Archiver," says Abrams, "where you can schedule a given pan/tilt/zoom shot at timed intervals and then archive a collection of shots into an SQL database. We'll soon be releasing a JavaServer Pages technology-based front-end to enable exploration of those archives through the Web."

Meanwhile, PRI's Look and Buy technology is also on the move. "One wants to be able to easily go from a catalog entry to the live camera view, and vice versa," says Abrams. "We're currently working with some high-end retailers to deliver a database driven system that tightly integrates our technology with an e-commerce catalog."

And finally, even Jini technology is finding its way into PRI's bag of tricks. "The Jini architecture fits well into our plans for managing large numbers of cameras," says Abrams. "The key feature is its ability to easily network small appliances. We're currently working with several hardware suppliers to incorporate Jini technology into our camera appliance architecture."

A Picture is Worth...

Perceptual Robotics likes to point out that their technology is the polar opposite of the fabled "vapor-ware" of the high-tech world. "One thing about our technology is that it actually works!" laughs Abrams. "It's not just some over-funded, venture capital, marketing glitz-o-rama. You can go to the sites listed on our page, and see major companies running their e-commerce and logistical management systems using our technology."

"Once people who already had Web sites include our cameras," adds Greenman, "their traffic often increases dramatically. The camera page becomes the most important, and most trafficked, and best loved part of their site. We've had businesses suddenly start selling banner ads just as a result of having a camera page."

And beneath the surface of these many business success stories, driving it all, is a healthy sampling of the secure, scalable, and cross-platform power of Java technology. "Just go down our list of customers," says Abrams, "They may not even know it themselves, but Java technology is running a big part of what they do. That's important to realize."

See Also

[Perceptual Robotics, Inc.](http://www.perceptualrobotics.com)

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[PRI Live Cams](http://www.perceptualrobotics.com/live/)

(<http://www.perceptualrobotics.com/live/>)

[PRI Photo Archive](http://www.perceptualrobotics.com/products/prodarch.htm)

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About the Author

Steven Meloan has covered the Web and the Internet for such publications as Wired, Rolling Stone, Playboy, and the San Francisco Examiner. He has also written for American Cybercast's award winning Web Episodic, "The Pyramid."

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