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NAVY SBIR TRANSITION PROGRAM

SPOTLIGHT

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Acquired by VideoRay, Blue Ring Imaging enhances Navy ROV operations with 3D visualization and mixed reality control technology

By Amie Alscheff

Blue Ring Imaging, a small business specializing in 3D visualization and virtual reality for unmanned vehicle control systems, was acquired in September 2023 by underwater robotics company VideoRay, which plans to incorporate Blue Ring's technology into its unmanned vehicles.

Earlier in 2023, the Navy selected VideoRay's Mission Specialist Defender Remotely Operated Vehicle (ROV) to serve as the foundation for the MK20 Defender ROV platform, supporting the Maritime Expeditionary Standoff Response (MESR) program. The MESR program will equip Navy explosive ordnance disposal (EOD) units with the ROVs to detect and neutralize underwater mines, particularly those found in maritime war zones. In May 2024, VideoRay was awarded a $92.6M five-year indefinite-delivery/ indefinite-quantity (IDIQ) contract, administered by Naval Information Warfare Command Pacific, for the continuous production, sustainment and development of ROVs for the MESR program.

"Subsurface robotics programs of record are quite rare," said Casey Sapp, who founded Blue Ring Imaging and is now vice president of strategy and emerging technologies at VideoRay. "This contract vehicle is one of the first production contracts for ROVs in the Navy, which makes it significant. It's a very interestingly worded contract because it's not specific; it's really about meeting an end user need for an ROV rather than a specific type of vehicle and so it allows us to develop a variety of different technology solutions to serve the customer off of one contract."

Image provided by VideoRay

Integrated onto the VideoRay Defender ROV platform, Blue Ring Imaging's technology will support the Navy's MESR program.

Blue Ring's technology, which was developed in part through a 2019 Navy SBIR award, will enhance the Defender's environmental situational awareness and underwater depth perception. It provides a camera system capable of wide angle 360-degree and 3D perception, along with a mixed reality software application which can run on a head mounted display (HMD) in an outdoor ruggedized environment.

"The thesis of the business that was sold to VideoRay," said Sapp, "was that visualization and interfaces for robotic control were moving from tablets and phones and PCs to headsets, and that there were a number of benefits to headsets that advanced control, and specifically manipulation, for the operators."

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Sapp described how better visualization capabilities enable ROV teleoperators to carry out more complex tasks. "All we're using right now is physical buttons and a single camera to do complex work. We want the robot to behave like a human, able to perform at the level a human can or better, and perception is a significant part of control." According to Sapp, if a robot is equipped with a 3D camera that can see in 360 degrees, displaying those sensor feeds in a headset provides enhanced depth perception as well as the capability to overlay augmented reality and mixed reality markers over a 3D view of the physical space rather than a 2D map. "If you have the right camera configuration and sensor array on the vehicle, then when you put a headset on it feels like you're actually immersed in that space in real time. You feel more like the robot. The term would be embodiment. And through embodiment, we can really transform the way work is done.

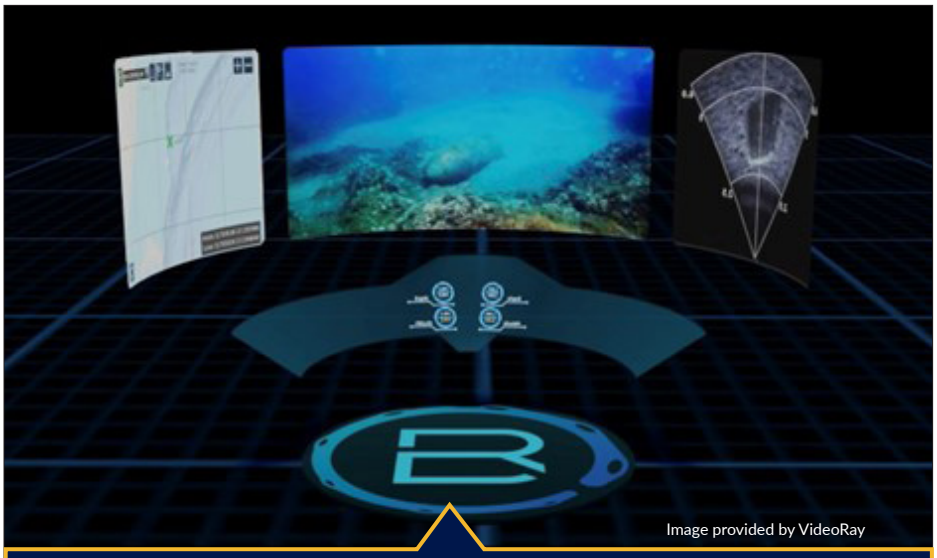

Image provided by VideoRay

Blue Ring's 360-degree camera system provides an immersive 3D view of the underwater environment.

"Teleoperation has a number of different levels. It's very common to see setups where someone is looking at streams coming in through a mobile phone or a tablet. Then there are new companies, such as teleoperating cars, that have maybe three or four screens in a concave array. And that gives them a little bit more field of view, a little more presence. But the perfect and the most ideal setup is to see the actual physical space exactly the way the robot sees it. That's what headsets are able to do, if you set it up right."

While many small defense technology businesses are founded by veterans with close ties to the military community, or by researchers with deep academic knowledge in a scientific field, Sapp came to the field of defense robotics as an entrepreneur.

"I was trying to start a technology company in the marketing and advertising space," recalled Sapp, "but it failed, and I fell into Hollywood. There were 360-degree cameras for live streaming surgery and sports, and they were being put on autonomous robots. But there was no underwater 360-degree camera, and there was just as much of a need. I began concepting multi lens or multi view camera arrays that allowed you to capture from many different angles and stitch them together to produce a high resolution 360-degree format. I became an expert at synchronizing, building, developing, managing and designing these camera arrays."

With his previous company, VRTUL (pronounced "Virtual"), Sapp created the first underwater 360-degree 3D camera and in 2017 produced the first ever underwater 360-degree virtual

reality live broadcast for ABC's Good Morning America. The live broadcast, which brought viewers an immersive view of a shark dive on a Caribbean reef, was a huge achievement but it also sent Sapp's career in a new direction.

"I was looking at the live stream as it was happening, and I was just amazed. I felt immersed. It felt like I was actually diving because I could put a headset on and look around in real time. I knew that there was something there, to match these novel camera systems with headsets." Sapp approached the Monterey Bay Aquarium Research Institute (MBARI) to test whether headsets would benefit ROV operators in terms of user experience and efficiencies of time and cost. Working with MBARI researchers, Sapp reconfigured and rebuilt his system for use with a deep sea ROV, then conducted research studying the user experience. That research showed that "every box was checked," said Sapp. "They had more situational awareness; they performed better."

"There is somewhat of a flywheel in applied research," Sapp concluded. By presenting a technology to other researchers as the missing piece that they need to solve their own research problems, he believes a small business can combine its expertise and R&D funding with others to create something that's ultimately greater than the sum of its parts.

"I think applied research is something you can sell. If you can find the right set of partners, they will pay you a fee to solve that problem for them so that ultimately they have a system or something physical they can continue to use afterwards. And then you just parlay that into the next thing to ultimately build the solution that you have in mind. MBARI still has that camera system and headset from 2017, and I believe they're still using it. They got what they wanted out of it, and I did too."

The work Sapp did at MBARI, which included demonstrations and two published white papers, caught the attention of the Navy. In 2019, an SBIR solicitation asked for essentially the technology Sapp had created, adapted for EOD applications. "I didn't even know what an SBIR was. Someone told me about it at the last minute. I looked it up and saw that the solicitation included links to some of the work I had done. I threw my hat in the ring, and I won it."

VRTUL ultimately received six SBIR awards focused on its virtual reality piloting system, including projects for both the Navy and the Air Force. The SBIR program introduced Sapp to VideoRay, as the Navy was evaluating its Defender ROV for the MESR program during the same timeframe. "Through the SBIR contract, we had access to their vehicles and did testing and integrations with them. That was really it—conferences and interaction, being able to ask questions about how the vehicles worked and getting them in the water with our technology. We hadn't sold anything to their customers. It was all R&D." Although the Navy's MESR selection wasn't final, Sapp said it was already clear that "if you weren't working with VideoRay, you weren't going to work with the Navy. They were now developing SBIRS to build out the capabilities suite for MESR at that time."

For both camera systems and ROVs, Sapp's technical approach has focused on innovative ways to combine commercially available components rather than designing and manufacturing them.

"Because this industry is changing so quickly, the goal was to use off the shelf everything with a little bit of custom coding and software, with

the expectation that the market's going to keep rapidly evolving and we couldn't put our chips on one sensor, one GPU. That's a really key part, I think, of robotics in general—that things are low cost to procure and can be replaced through commercial means. There's nothing proprietary about any of the hardware. You're seeing this in Ukraine and Eastern Europe at the moment. I've been focused on how to push the limit and performance on the lowest cost sensor suite. No company builds every single piece and so you often find yourself working with your competitor because you need something that they have in order to fill out the entire system."

As the small company pivoted to defense robotics, Sapp phased out VRTUL's cinematography production business and eventually formed a new company, Blue Ring Imaging, "a new entity that looked like a defense company and didn't have any of the baggage of association to Hollywood," according to Sapp. "I put together a nice little portfolio of R&D contract vehicles where I could really develop a decent hardware-software solution for unmanned vehicles. And by the time I had reached maturity for scaling, and I was about to sign customers up in the commercial space to grow this business, VideoRay came in and acquired us.

"That's how I started," Sapp concluded, "essentially in a commercial space, not even thinking that defense was an opportunity or thinking that I had a way to make inroads there. But once I won the SBIR, I started to become more informed about how small businesses can work with the government and have more of a focus on defense."

Looking back at his journey from the film industry to defense, Sapp pointed out the stark contrast between the two worlds. "I like defense because they invest in R&D. They're patient. They have more of a long-term view on hard concepts. They give you end user feedback. Minus those times when the government shuts down, there is a fair amount of confidence and ability to forecast. That stability allows you to be patient and keep people together on staff to build something special without needing to go to the venture community or private equity community that has potentially a shorter timetable for results. The Navy isn't expecting results in 24 months or 36 months. As long as you're making progress and meeting the milestones agreed upon, it could be 10 years. Hollywood expects something very fast in return. Symbolically, it's like they're pouring gasoline on a fire—if they see something they want to be the first to it. They want to jump in really quickly, spend a lot of money, test it and then move on. The Navy is, obviously, more methodical and patient and willing to write checks over a longer period of time to see you develop it. That's really important for some of these unproven technologies."

Sapp also noted some aspects of working with the defense industry that may be off-putting for entrepreneurs. "When you work with the defense industry, they have what's called the 'time tax.' You get funds, but it takes a long time and there's a lot more hoops to jump through—a lot more paperwork, a lot more reports, a lot more check-ins. It is very, very bureaucratic and intensive. They gave us access to the ocean, which is expensive. They gave us access to VideoRay vehicles, which is expensive. They gave us access to end users, which is expensive. We got things that you can't put a price on, in some respects, but there was a lot that had to go into it. Because of the amount of money we were receiving from the government, my little company of five people had to go to a Defense Contract Audit Agency (DCAA) government

accounting system. That effectively meant I was spending 10% of my revenue on just bookkeeping, accounting and invoicing. I went from $150 a month doing bookkeeping to tens of thousands of dollars. So, I think working with the Navy has a lot of pros and it also has a lot of cons. It's not for everybody. SBIRs obviously helped me achieve my end game and in that way it was successful, but it was very painful. I'm glad I was able to have that experience. I don't know that I would go for another SBIR again though. I'm kind of burned out."

Blue Ring's mixed reality software application for ROV control runs on a head mounted display (HMD) ruggedized for outdoor use.

In his new role at VideoRay, Sapp has spent a busy first year integrating his team of former Blue Ring Imaging employees, doing business development and creating new product roadmaps, while still managing Blue Ring's existing contracts with ONR and others. "Because VideoRay needed to update their primary camera on the vehicle, they used technology we were building. We got Accelerate the Procurement and Fielding of Innovative Technologies (APFIT) funding and accelerated the R&D and development of that individual singular monoscopic camera that was on the front of the VideoRay vehicle. We had to kind of take one step back to take two steps forward. The first six months was getting the team integrated, standing up a software group, accelerating this monoscopic camera." In 2025, Sapp hopes to begin integrating Blue Ring's more complex 360-degree cameras and VR controls into the MESR program's ROVs.

For the future, Sapp looks forward to many further innovations in robotics. "The dream is that any person who walks off the street is able, with little to no training, to put an ROV in the water and have it go perform a complex task, with them in the loop and having the ultimate decision making authority. Making robots easy to use is something that's going to take decades."

VideoRay