

Seeing through the future

By [NICKY BLACKBURN](#)

Dr. Yaakov Amitai, an expert in the field of electro-optics and advanced optical imaging, was actually looking for a position with a high-tech start-up when he developed his own optics innovation. Amitai, who had spent a number of years at the Weizmann Institute of Science, and as head of the optics group at El-Op, had already received a number of tempting job offers, but instead decided to take a risk and set up his own company.

Amitai approached an old friend of his, Dr. Rami Aharoni, who he had met at Stanford, and asked if he would be interested in helping set up the company. Aharoni, a co-founder of ScanMaster Systems (IRT), a company that was sold to a US corporation in 1987, and then to Elbit Vision Systems in July 2004 for \$8.5 million, had just retired and was looking forward to taking life easy.

"It took me four months to understand what Amitai was talking about, but when I finally did, I realized this was revolutionary," says Aharoni, who is 49. "I understood that this was the largest thing I was ever going to come across, so I decided to join in."

It was 2000, the start of the recession, and the two scientists began hunting for seed financing. The industry, however, was skeptical, claiming that Amitai's invention contradicted various rules of optics and would not work. It was only at the end of 2000 that Amitai received the funding he was looking for from Israeli VC firm, CAP Ventures, and finally set up Lumus.

FOUR YEARS LATER, Lumus, which is based in Rehovot, has developed a promising technology that can be used to create personal, wearable, near-to-eye virtual screens for mobile applications. In January, the company also received investment (reported in Globes, Israel's financial daily, to be in the region of \$6m.) in a series B financing round led by Motorola Ventures, and joined by Jerusalem Global Ventures.

So what are personal displays? Basically, Lumus has developed a Lightguide Optical Element (LOE), which enables a user to project images or data from computers, palm-units, DVD players or cameras, to a high-resolution virtual display. This display appears as a large full-color screen of some 17 inches in size, located a short distance in front of the user's eye. It is visible only to the user. And the virtual screen blocks only a small percentage of the user's field-of-view, allowing him to maintain eye contact with the periphery.

The LOE – a small, flat, transparent optical plate – transforms small images into large images, with a large field of view. Images from small and miniature sources, such as LCD, LCoS or OLED devices, are projected into the plate, and a set of reflective components reconstruct and project them directly into the viewer's eye.

This basic technology can be used for a range of compact personal displays in a variety of configurations. Already the company has developed and launched two near-to-eye products, the Head Worn Display (HWD), a small and light see-through display that can be attached to various headgear or worn like glasses; and the Wearable Smart Terminal (WST), an HWD that can be combined with a pocket PC or other

computers using a wireless network. This makes it ideal for a wide range of mobile and outdoor applications.

At present, Lumus is only selling its products to the high-end market – professionals in medicine, security and the military. Surgeons, for instance, can use the product to help them perform operations, while security officers can focus on what is going on around them while they view real-time video images from CCTV cameras. Policemen can use the device to see critical information, such as suspect photos and criminal records while tracking a suspect. Soldiers, on the other hand, can view maps and ariel photographs while navigating new terrain.

Sometime during the next two years, the company plans to launch a new line of products specifically for the consumer market, which the company regards as the key money-spinner. Users will be able to browse the Net, watch DVDs while on the go, carry out training, improve their driving, and even take part in augmented reality games, in which virtual images are superimposed on reality.

Aside from existing products, Lumus is also working to incorporate its technology into a mobile phone, enabling users to replace the phone's tiny, low-resolution screen with a large, high-resolution virtual screen that only they can see. This would allow users to view a complete Internet page rather than have to scroll laboriously through pages, or to see the whole of a map, or view a downloaded movie comfortably.

"Now we can have a huge information-centric device in a small physical space," says Aharoni, CEO of Lumus. "It's the missing link."

UNTIL NOW, cellphones have managed to overcome many physical barriers of processing power, bandwidth, and infrastructure. The major thing missing was a large yet compact, high-quality, wide-field-of-view display.

Aharoni is not prepared to discuss current sales figures or projected revenues. He will not even discuss when he expects certain products to reach the market, how much the company has raised in past financing rounds, or how many people it employs.

"We have to be careful for two reasons," he explains. "Firstly, there is no advantage in discussing this information, and secondly, we have many competitors. It's not a security issue, it's just the way we see our business. We don't need to discuss our intentions. As our products become available they will speak for themselves."

Competition is certainly something that Lumus must never ignore. This is a field where giants already dominate. Players in this segment include Microvision, Mitsubishi, Olympus, MicroOptical, Eye-Top and Shimadzu, all of whom have developed their own personal display products. Aharoni believes that Lumus has something special to offer, however. When the company first applied for a patent, it received it without any difficulty, according to Aharoni, because there was nothing remotely like it.

"We believe we have a much better technology than any of these other companies," says Aharoni. "Every other device on the market is heavier and larger than ours. We can make our devices very small and yet maintain a high-quality image, and we believe we have a strong technological advantage."

In addition, Lumus has ensured that all of its LOEs are transparent. This is important because it allows the user to see everything going on around him while he views the screen. Many rival companies, particularly those aiming at the mass market, have created non-transparent products that are simpler to develop, but block peripheral vision, and create a goggle-like effect. This, says Aharoni, will not be socially acceptable.

"It will not be tolerated if people walk into an airport lounge, say, and see a whole group of people wearing goggle-like devices on their heads," he asserts. "It is important to maintain eye contact with the environment.

Another ball in Lumus's court is Motorola, a communications giant that saw \$31.3 billion in sales in 2004. For a small Israeli company to break into a market like this, it needs to team up with a large international player, and Motorola is just that player.

"The Motorola deal is something that will help us very much in defining and marketing our products," says Aharoni. "We actually chased after Motorola until they caught us."

"WE ARE excited about this strategic investment in Lumus," says Matthew Growney, managing director of Motorola Ventures. "Its revolutionary optical technology has the ability to transform the way consumers view digital and rich media. We expect Lumus' enabling technology will complement many of our products, including our compact personal mobile displays, our public safety solutions and our automotive applications."

Lumus is also working with other international companies, and has a number of projects on the go. Surprise, surprise, Aharoni does not want to reveal any names. Motorola, however, is the first of these companies to actually invest.

Today, Aharoni believes his main problem is that the scope is so huge that he must limit himself and focus at all times.

"There are so many potential applications for this technology that we cannot possibly do them all ourselves. In some cases we will create our own products, as we are now, but in others we will have to rely on partners and OEM agreements. We must ensure that we only pick up on the most promising applications."

And is Aharoni as optimistic as he was at the start?

"Every month that goes by, I feel more and more that this thing is really enormous," he says. "If we work this right, we should end up with a major international company."