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WHAT'S NEXT

For Your Viewing Pleasure, a Projector in Your Pocket

By ANNE EISENBERG

IT takes squinting and guesswork to make out the details of postage-stamp-size snapshots displayed on cellphones and digital cameras. But researchers are working on pocket-size projectors so that one day people will be able to see a high-resolution slide show right out of a camera, a cellphone or an organizer.

In the future, the miniprojectors may also be attached to DVD players, so people can watch a movie with a TV-quality picture on a nearby wall.

Most standard digital projectors are bulky. Even the trimmest video projectors used for office presentations have the dimensions and the weight of a telephone book. But prototypes of a new generation of miniprojectors, including ones only slightly thicker than a credit card, have been developed, some based on light-emitting diodes, others on lasers.

"There will probably be two or three different technologies for miniprojectors that will coexist," said V. Michael Bove Jr., who has developed a prototype. Dr. Bove is director of the consumer electronics research project at the Media Lab at M.I.T.

"The important point is that whatever the technology, there are going to be significant differences from present office video projectors and projector TV's," he said.

For example, future miniprojectors designed to be embedded in other devices may be used to cast images like control panels or maps onto a car dashboard.

"They are going to radically alter the way we work with projectors when you can download a map onto a phone and point the projector at a surface to get a higher-resolution image," Dr. Bove said.

There are still problems to solve before inexpensive miniprojectors the size of sugar cubes roll off the assembly line. "It's going to take a while to make the projector design efficient," he said. Power consumption is an important issue since in many cases the projector would draw power from the cellphone or whatever device it is coupled to.

At present, Dr. Bove said, projection TV's and video projectors can use hundreds of watts of electricity, but only a couple of watts at most will be available when they are powered by batteries in hand-held devices.

Because of the challenges, Dr. Bove predicted that before the projectors are fully miniaturized, the earliest versions would appear as attachments to laptops. "There's more room and power on a laptop," he said. "Eventually, though, they will find their way into hand-held products."

At Mitsubishi Electric Research Laboratories in Cambridge, Mass., Ramesh Raskar leads a group that has demonstrated a pocket-size projector meant one day to attach to cellphones, digital cameras or organizers.

Lumileds Lighting, a company based in San Jose, Calif., that makes extremely bright light-emitting diodes, has also developed a prototype for a compact projector. Steve Paolini, director of business development, said it was meant not for big-screen displays in meeting rooms, but for personal uses. "Our initial goal was a screen the size of a piece of paper," he said, "with the size and brightness of a laptop screen."

The Lumileds projector is not for sale; it was built, Mr. Paolini said, to demonstrate the power of light-emitting diodes. "But there's no technical reason why pocket projectors can't be built now," he said. "It's a market issue."

Lasers rather than L.E.D.'s are the basis for a hand-held projector in development at Light Blue Optics, a company in Cambridge, England. "We want a device that you can download films to, press a button and see a huge screen projection," said Adrian Cable, director of the company.

The large projections are produced holographically. "These are not the three-dimensional holographic projections of Princess Leia in 'Star Wars,' " Dr. Cable said, but instead two-dimensional ones produced by an optical process different from standard projection.

Dr. Cable, who has a doctorate in holographic optics from Cambridge, said the basics of projecting video holographically have been known for 20 years. In it, light is forced to propagate not in straight lines but through small gaps that force it to diffract. Precise control of this diffraction can produce holographic images.

"Historically, images projected holographically have tended to be grainy and poor in quality," Dr. Cable said. And even when the images were acceptable, the computational problems involved in calculating the holograms were time-consuming. "It used to take 20 minutes to calculate the hologram for one video frame," he said.

But the Cambridge group's work has resulted in improvements in image quality and processing speed, he said. "It's much simpler to form an image holographically," he said. "You need smaller and fewer lenses, leading to a smaller projector."

At Mitsubishi Electric, Dr. Raskar and his group have developed several methods to demonstrate how people will interact with projector images in the future. For example, they have developed a method to stabilize the projected image so that once it is fixed on a wall it will not move with subsequent hand movement. Then they developed a way to click and drag items within the projected image from one place to another, using a game of tick-tack-toe projected on a wall as an example.

"Now you can actually interact with the projected contents," he said. "You point where the piece is, and then drag it to where you want it to go."

Mr. Paolini of Lumileds also thinks that game playing is in the miniprojectors' future. When he took one of the prototypes home, he said, his son started playing with it on his bed, aiming it at the walls.

"Think of it," Mr. Paolini said. "You can play games on the ceiling."

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