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Exactly to the Point

With its new development, "**Fiber Optical Information & Visualization Equipment,**" Schott Fiber Optics plans to revolutionize the technology of variable message signs.

▶ The display changed every few seconds: first the number "90" appeared in white, then a red "x", followed by a green arrow. It sounds like a traffic sign along the highway, but it is in fact a test device in the R&D laboratories of the Fiber Optics Division of Schott Glas in Mainz. Here, researchers are working to fulfill a number of demands: "With this new technology, we want to achieve more than just traffic signs," says Wolfgang Streu, Project Manager at Schott Fiber Optics. At exactly that moment, the display shows a yellow "smiley," a task which would be too much to handle for the conventional variable message signs now in use in Germany.

Engineering genius

The catchy working title, FIVE is an acronym for "fiber optical information & visualization equipment", and in simple terms, it means using a projector and a bundle of glass fibers to transmit information, which is then made visible on a display.

This concept is not new, of course. Luminous traffic signs made with glass fiber optics are already in use today. But these signs have their limitations in terms of projection and resolution. Each light point can only be used for one signal. Red is always red, green is always green. This static approach only allows a limited number of signals.

Schott's new development, however, has all sorts of untapped possibilities because developers have been able to overcome the weaknesses of the old systems. For one thing, a single light source is sufficient with FIVE. In a stroke of genius, Schott engineers – together with their colleagues at sister company Zeiss in Jena – were able to break down the light beam into red, green, blue and white with the help of a so-called color wheel. From these primary colors it is possible to represent up to 16.7 million colors, a number that computer fans know from the color setting of their monitors. And thus FIVE is able to offer the same broad color representation.

Conventional variable message signs can only handle a limited amount of information.

This is how FIVE works: the image that is supposed to be seen on the display appears on the computer screen.
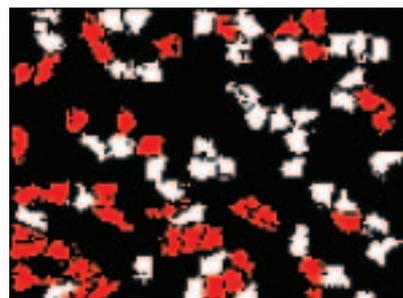
Special software breaks down this image into what looks like a random jumble, …

The image fragments on the screen of the test unit are rearranged to an arrow.

As it continues on its path, the dispersed light beam strikes a DMD chip, similar to those used in modern projectors. "This chip is about the size of a postage stamp," says physicist Ekkehard Gaydoul, who is one of the inventors of the FIVE system at Schott.

"Fingerprint" technology is the answer

However, the scientists still had one hurdle to overcome before achieving representation on the display: directing the path of the light through the glass fiber to the right position on the display. This procedure is not a problem, for example, when using a mini-matrix with four light points. The glass fiber that receives the light beam at the upper left also transmits it to

the upper left of the display, and reproduces the light signal there too. "But even our test model had a matrix of 13 by 17, or 221 points. To connect each single point by hand is complicated and very time-consuming," explains Streu – and thus too costly. Furthermore, four to six times that number, i.e. between 800 and 1250 image points, were planned for the commercial application. "We had to find another method of correctly coordinating the image points," says Streu.

Fingerprint technology ultimately offered the solution. "In the first step, a fine light beam is used to determine the path it will take through the glass fiber bundle," explains Gaydoul. The beam with the

... which is then reconverted by the glass fiber matrix into the original image. The FIVE system permits unlimited image possibilities in terms of shapes and colors.
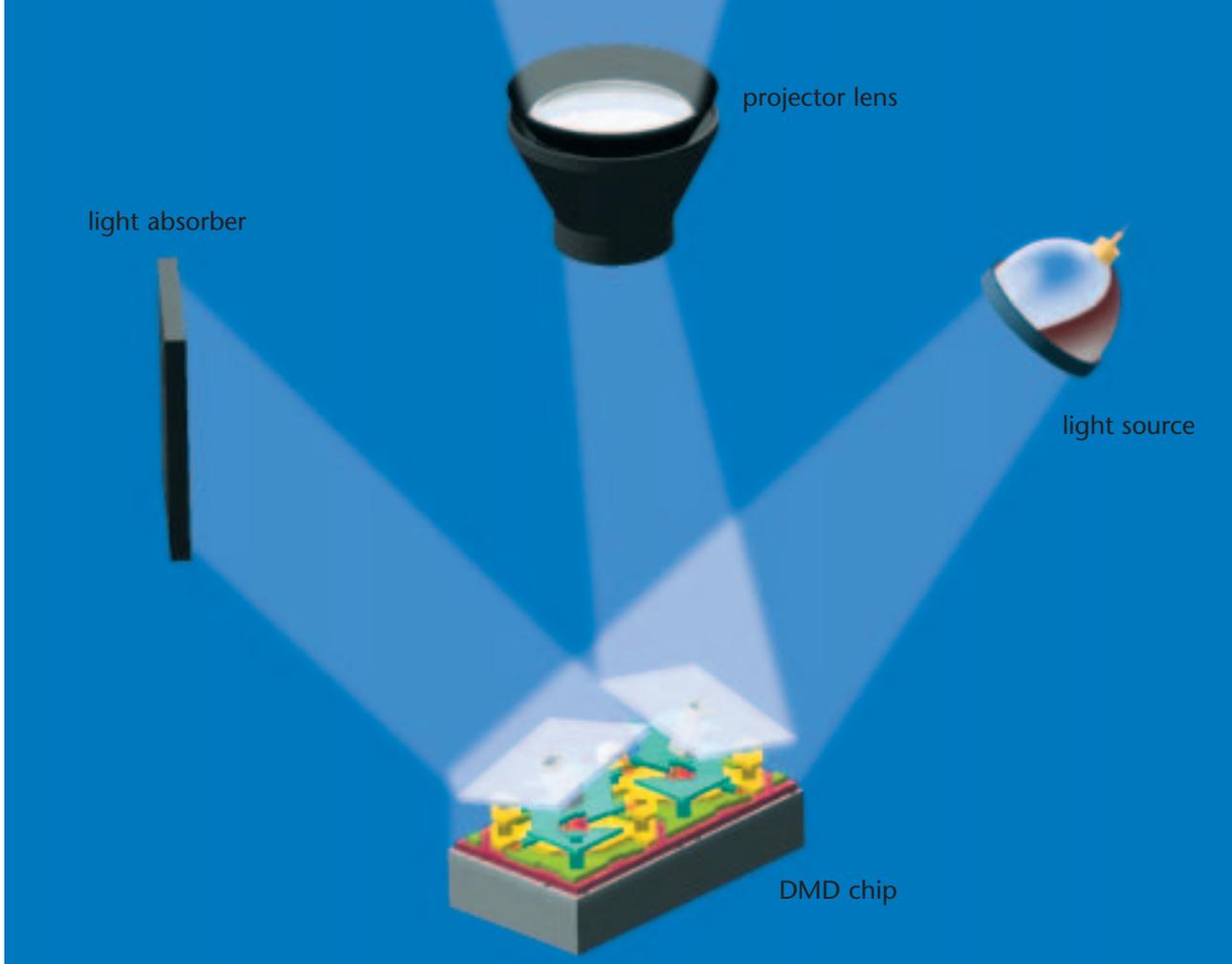
entry coordinate A 1 will emerge, let's say, at G 8. "The arrangement is completely random and because of the large number of glass fibers, different for every unit. That is why it is called a fingerprint."

Like a puzzle in a mixer

Software developed by Schott stores this apparent chaos and then breaks down the image or the signal that one wants to represent with FIVE. In keeping with the above example, for instance, the light information that should appear at the G 8 field of the display will be directed by the software to the A 1 field, based on the stored fingerprint. Here it is fed into the optical system – with an amazing effect. The signal fed into the unit looks like someone had thrown a puzzle into a mixer. But at the end of the process, which is performed just once for each display, the finished image appears on the screen with each point at the right spot. "We have applied for a patent for this process," says Product Manager Streu.

light absorber

projector lens

light source

DMD chip

The position of the reflector on the DMD chip determines whether the light beam will be transmitted through the projector lens to the display or absorbed.

The advantages of the entire system are quite obvious:

- Every image point can assume every color.
- The outside temperature has no influence on the color intensity.
- The light intensity does not decrease over time (no light degradation).
- The housing of the display can be kept very thin, since only the fiber optic light guides – and no electronic components – are assembled there. Nor are any additional devices required (such as ventilators).
- The system is easy to maintain because the technical parts and the display are kept apart. The few working parts, and especially the lights, are easily accessible for replacements.

Streu and his team expect to have FIVE ready for market introduction by the end of 2003. "We hope to find a strong partner for further development work," says Streu.

Initial talks with selected companies in Europe and the United States have been encouraging.

Schott's engineers are still improving some details and the interested companies clearly see the potential of this development. "The possible applications extend far beyond traffic technology," says Streu. One possibility would be to use this technology in signage with large numbers of individually triggered, light-emitting points, such as passenger information on railroad platforms. And because of the enormous optical flexibility, more sophisticated applications are also feasible, for example FIVE displays as advertising vehicles.

Wolfgang Streu is optimistic: "We have great expectations for our new development." ◀
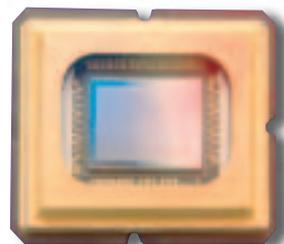
The mini-reflectors on the DMD chip can change their position in less than one millionth of a second.