BY **MIKE WOOD**

Pixelated headlights

A SPOTLIGHT with some kind of dynamic controllable gobo has been a holy grail of entertainment lighting for as long as I can remember. I experimented with early pocket calculator style LCDs myself back in 1978, with, you won't be surprised to hear, no success! The ability to change gobo patterns to anything you want, or even to have moving patterns seems, on the face of it, to be a feature we couldn't live without. There have been many attempts over the years, Vari-Lite and others have experimented with liquid crystal gates, and there have been a number of products based around video projector engines. The High End Systems' Catalyst and DL ranges, the Robe DigitalSpot range, the Barco DML-1200 (remember that?), and many others. However, most of these products had a relatively short life and are now discontinued. Why is that? I believe it's all about performance versus expectation and cost. The products I've mentioned were full spectrum color video projectors, they projected high definition imagery, not gobos. Additionally, they were all expensive products with a light output that didn't live up to the price. The light output from these products may have been fine for a video projector, but were well below what we expect for an automated spot light. The high cost and low output meant their use is limited. They ended up being used in relatively small numbers projecting scenery, corporate logos, or stage elements, not as general-purpose lights. You can't afford to use one of these products just to project an out-of-focus woodland break-up gobo pattern across a stage, it doesn't make economic sense.

You may have noticed that I left one well-known product out of the list above, I did so deliberately as, to my mind, it was a very different kind of unit. That product was the Icon M from Light and Sound Design. Superficially it falls into the same category as the other luminaires I mention, but it had a couple of key differences. Firstly, the beam was round, rather than a 16:9 rectangle, and secondly and most importantly, it was monochrome. The Icon M was a white light product with standard CMY subtractive color mixing allowing you to color the entire beam. No full color images, just black and white gobos using a single chip DLP micro-mirror engine from Texas Instruments. This was a product that was designed to be used as a light, not as a movable projector, and because of that, to me (even though I was heavily involved with Catalyst and its successors) it remains the most exciting product of its type. I was blown away when I saw it at LDI in 1998. Unfortunately, it was also too expensive and too dim to make economic sense! However, I believe it got the concept 100% correct, so how do we get to an Icon M that does make sense? How do we get to a price and output that means you can put 50 of them in the rig and use them as true general-purpose workhorse luminaires, just with an infinite selection of gobos? We don't need 4K images and full color imagery, a lower resolution would be just fine.

We've traditional looked to the video industry for this kind of technology, thus the use of DLP and LCD engines, but, if we keep doing that, we'll never break out of the full color/resolution/cost trap. One place I think we might be looking instead is to the automotive industry and the newest designs for adaptive car headlights. The automotive industry is many times larger than our own and has the dollars to invest in some fundamental research that we can only dream about. These technologies go under various marketing names: matrix headlights, high resolution headlights, and multibeam headlights for example. They all have the same basic goal. Make the headlight beam spatially controllable so that you can light the road ahead but avoid dazzling oncoming drivers. Effectively what these systems do is project gobos, gobos that are dynamic and that cut out portions of the beam where light isn't wanted.

> **"… the next Icon M might come from Mercedes-Benz."**

Mercedes-Benz was one of the earliest companies to invest in this kind of technology, in conjunction with Hella they introduced a system using 84 individual LEDs arranged in three parallel rows. **Figure 1** gives an example of the output. No, it's not high-res video, but it could be a gobo.

The engine design can be seen in **Figure 2**, basically quite simple but with some

Figure 1 – Mercedes-Benz / Hella Multibeam Headlight

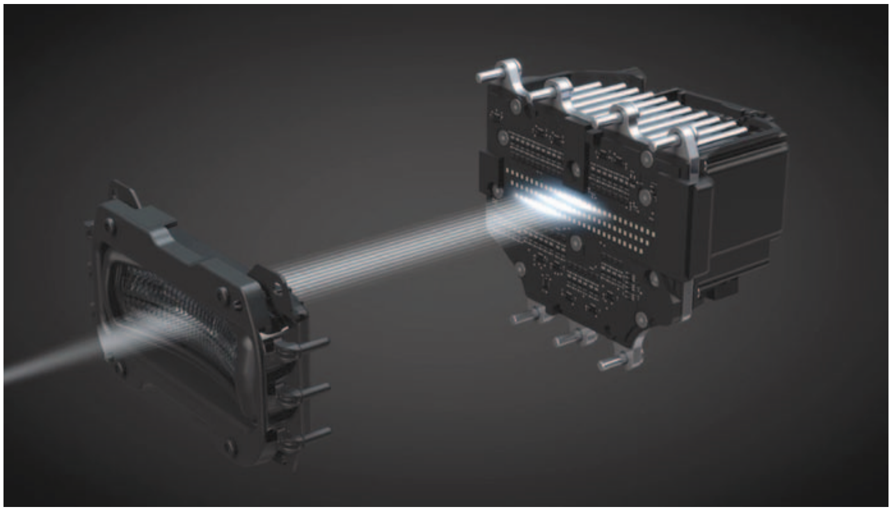

Figure 2 – Hella LED Engine

Figure 3 – Audi Matrix Beam

clever optics to generate a headlight-style of beam. The real smarts are back in the controller which uses cameras and other sensors to determine which LEDs should be on, and which off.

Audi, another German luxury brand, has gone in the same direction and offers a system with 32 LEDs arranged in two rows. Each of these LEDs has 6-bit (64-level) dimming, so you can get a very wide range of beam distributions and brightness. **Figure 3** shows an example staged by Audi where the system has detected the flashlights held by the two people and removed those LEDs from the output to avoid dazzling glare.

> **“Effectively what these systems do is project gobos . . .”**

Do either of these examples look ready for use in a theatre? No, not yet, but there's definitely potential here. These are relatively inexpensive systems. Very low resolution, sure, but I wonder if something like 1,000 pixels would actually be adequate for many gobos and a great fit for our application?

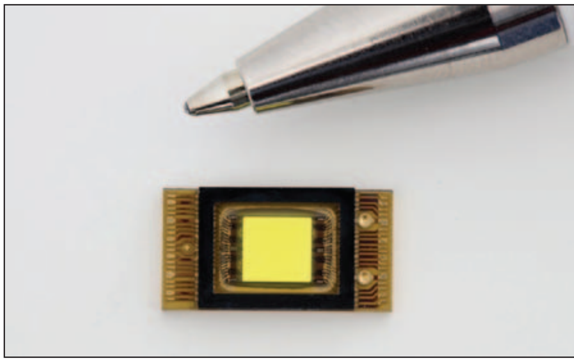

Figure 4 – Osram Eviyos LED Matrix

With that in mind, take a look at a recent offering from Osram, again working with Mercedes-Benz. This chip, dubbed Eviyos, is an LED array with 1024 white LEDs in a 32 x 32 array. The whole array is only 4 mm in size and emits around 3,000 lumens in total.

This is getting really interesting, 3,000 lm is not huge, but four of these could


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Figure 5 – Eviyos Headlight

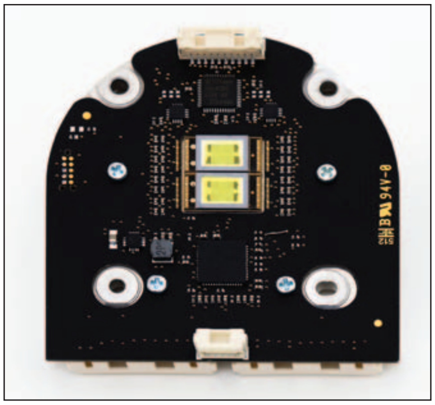

Figure 8 – Eviyos 2 Chip Layout

provide 12,000 lm which is starting to look respectable. Add some optics, such as shown in **Figure 5**, and you get a result like **Figure 6**. It looks to me a bit like early TV images from the 1930s using mechanical scanning systems, but I also think it could make some interesting gobos!

Mercedes-Benz have experimented with using three of the Eviyos arrays in a headlight, not in the way we'd like to use them perhaps, but the potential is definitely there. **Figure 7** is a close up of a matrix and **Figure 8** shows a prototype layout. Another


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Figure 6 – Eviyos Projection

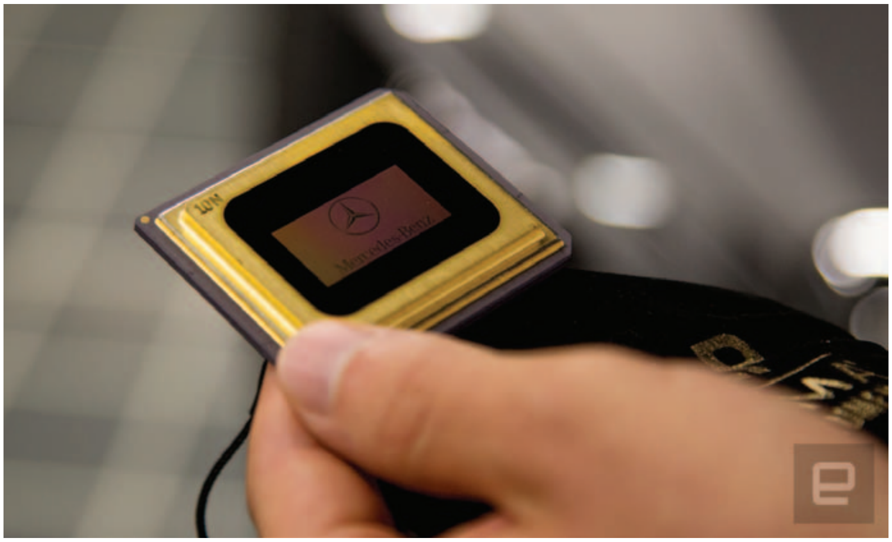
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Figure 9 – TI Mercedes-Benz DLP

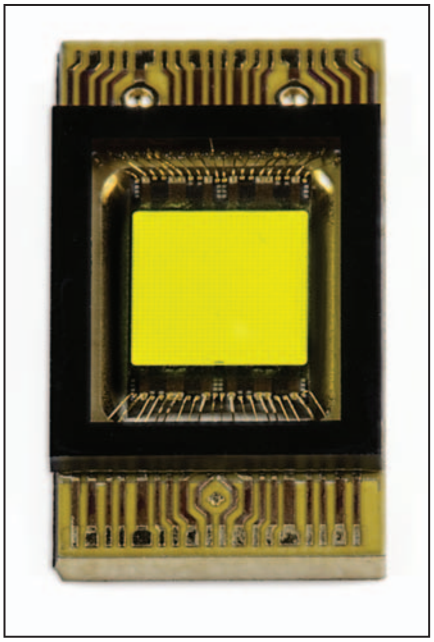

Figure 7 – Osram Eviyos LED Chip


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Figure 10 – TI Mercedes-Benz DLP Output


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Figure 11 – TI Mercedes-Benz DLP Projection

advantage of this kind of system over an actual gobo, or any video device, is that they are very efficient. Light is only produced in the places it's needed in the image. No wasted light.

My final example brings us round full circle to where we started. DLP chips from Texas Instruments (TI). Mercedes-Benz has been experimenting with these as well. This is very much a top-of-the-range design, and I'm not sure what kind of price it will be. However, TI has developed a special DMD engine for automotive use, 1.3 megapixels in a 2:1 aspect ratio, so it's possible if these take off in cars that the volume pricing may drop.

Particularly interesting is the example shown in **Figure 11** where the headlight and DLP are used to project road signs on the road in front of the car. If that isn't a gobo, I don't know what is.

If you live in the USA you won't have seen any of these headlights yet. None of them are legal here as our regulations haven't kept pace with the technology. The current regulations still require high beams and low beams to come from separate sources and to have very specific pre-determined light distribution patterns. I'm sure we'll get there eventually though.

I'm not saying that any of these headlight light engines are ready to be used as-is in an entertainment lighting product. They aren't. What's interesting however is the technology that's being developed. Could a 1,000 pixel LED array be used in a theatre luminaire? Yes, I think it could. We've never been a large enough industry to do fundamental research, our strength has always been at repurposing developments from other, deeper pocketed, fields. Automotive could be one of those and the next Icon M might come from Mercedes-Benz. ■

Mike Wood runs Mike Wood Consulting LLC, which provides consulting support to companies within the entertainment industry on product design, technology strategy, R&D, standards, and Intellectual Property. A 40-year veteran of the entertainment technology industry, Mike is a past President of ESTA and Co-Chair of the Technical Standards Council. Mike can be reached at mike@mikewoodconsulting.com.