Lightfair 2017 Conference Session:

Ambient Luminescence and Experiential Design

Supplemental Handout Material

By Brad Koerner

Below are 4 articles I originally wrote on my Linked In account, exploring the concepts and potential surrounding embedded lighting – the fusion of lighting with architectural materials.
The pieces included (in order below):

- *Exploring the future of embedded architectural lighting*
- *Think big: How embedded lighting will disrupt traditional architectural surfaces*
- *A baby snuggy and the future of architectural lighting*
- *Create unique guest experiences by combining interactive controls with embedded lighting*

Enjoy – Brad

Exploring the future of embedded architectural lighting

Architectural lighting is poised for a dramatic transformation: LED technology now allows us to integrate lighting directly into a wall or ceiling surface, with little energy consumption, heat, or maintenance to worry about. This fusion of *light + material*, of embedding lighting elements directly into architectural surfaces, opens up fresh new approaches to creating eye-catching spatial experiences.

For the past two years my team at Philips Luminous Patterns has explored the creative possibilities of “embedded” patterns of light, along with the supporting technology, design and service processes needed to drive widespread adoption. We believe that architects and interior designers have long tried to break free from the constraints of traditional light fixtures, to use light to add a visual richness to architectural surfaces. But custom integration of embedded lighting has been difficult to specify and costly to install, limiting broader adoption. We’re developing a flexible and customized system that accommodates an enormous range of creative styles, along with some interesting technologies to speed the design, visualization and fabrication processes.
We believe that transitioning from discrete light sources to light as an integral property of interior surfaces will change the way people perceive, occupy and enjoy architectural spaces, particularly in hospitality, retail, and public applications.

Light Effects – A "Play of Brilliants"

Mid-century lighting designer Richard Kelly identified three distinct types of lighting: *Focal Glow*, *Ambient Luminescence* and *Play of Brilliants*. We believe that a "*Play of Brilliants*" is key to creating new paradigms in modern lighting. To quote Kelly:

"Play of brilliants is Times Square at night. It is the eighteenth century ballroom of crystal chandeliers and many candle flames. It is sunlight on a fountain or a rippling brook. It is the rose window of Chartres. Play of brilliants excites the optic nerves, and in turn stimulates the body and spirit, quickens the appetite, awakens curiosity, sharpens the wit…."

Contemporary architects and interior designers, while still rooted in Modernism, are reinvigorating the visual richness of architectural design with digitally created parametric forms, geometric patterns, and innovative uses of low-cost materials. Luminous elements that incorporate a wide dynamic range of brilliance, diffusion and shadow readily fit into these current design trends. The magic qualities of light that Kelly so eloquently describes, fused into a modern architectural language, seem a perfect fit for clients hungry to create physical brand experiences that attract, delight and retain customers.

Experimenting with New Light Effects

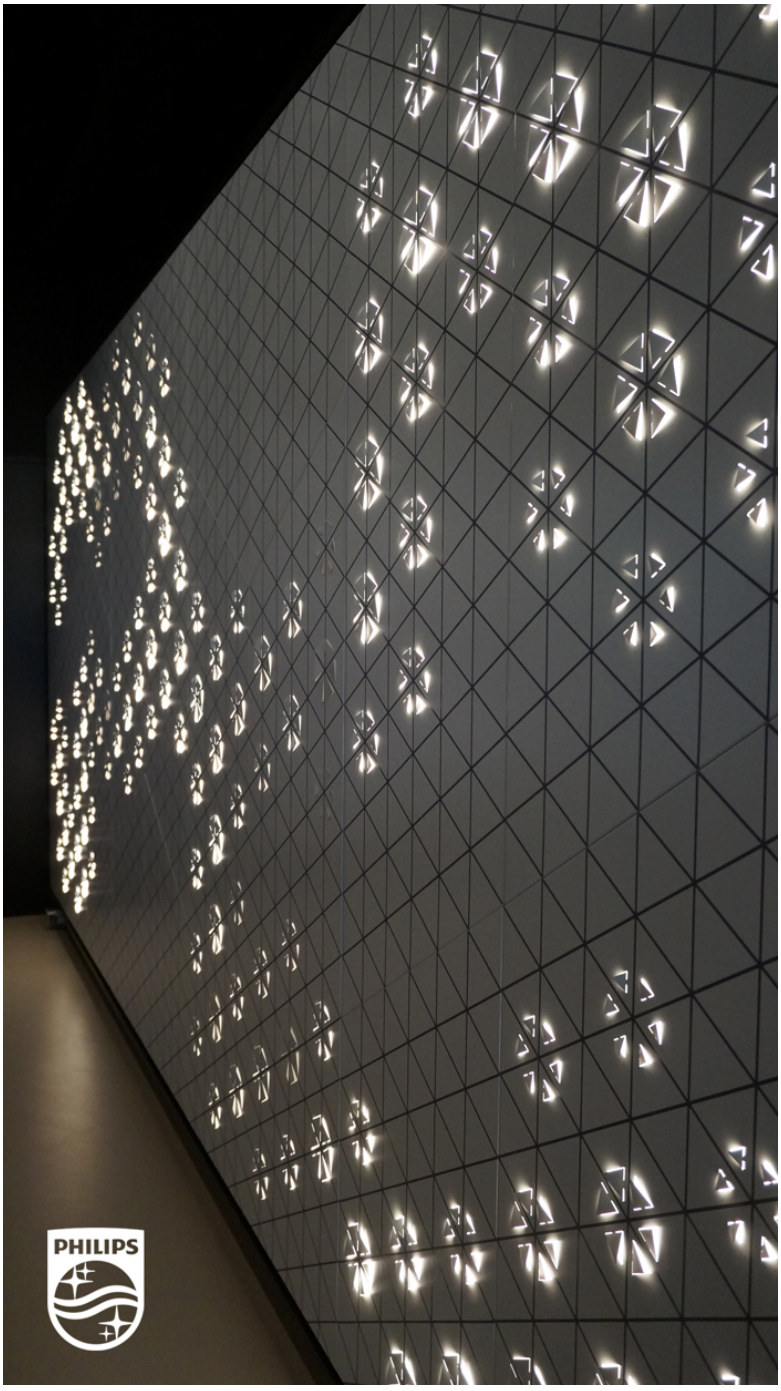
Luminous elements can add a "dynamic range" to architectural surfaces that add a level of spatial experience – a feeling that the architecture is alive, responsive even – that is simply not possible with either traditional surface materials or discrete lighting fixtures.

Romance
Ironically, with the state-of-the-art technology we're using in Luminous Patterns, one of the first types of lighting effects we explored was candlelight.

Candles have a timeless beauty, creating a delightful sense of warmth, brilliance, and animation. Combined in a glass holder (such as a tea light), candles produce a rich mix of brilliance, shadow and soft luminosity – most literally a "*play of brilliants*". We wondered if we could use the latest in LED technology to take the romantic feeling of candlelight, but express it somehow as an integral feature of architectural wall surfaces. We designed a special optic that creates a feeling of sparkle; paired it with a special LED that accurately creates the rich golden light of a candle flame; and married it to a digital control system that generates subtle flicker effects. A cluster of these across a wall surface creates an attractive pattern of sparkle, brilliance and warmth.

Motion

Another opportunity we recognized was the potential to create a sense of linear motion, for example in retail locations looking to create an experience of dynamic action and speed like athletic stores or auto showrooms. We're experimenting with a unique linear optic with an internal light guide where light can fade from one end to other, creating an sense of light streaking across the surface.



Silhouette
We're also experimenting with sculptural forms that create delightful plays of light and shadow across surfaces. We've developed 3D shapes folded out from the surface in front of internal backlighting, creating stunning compositions of silhouetted shapes and graphic elements.

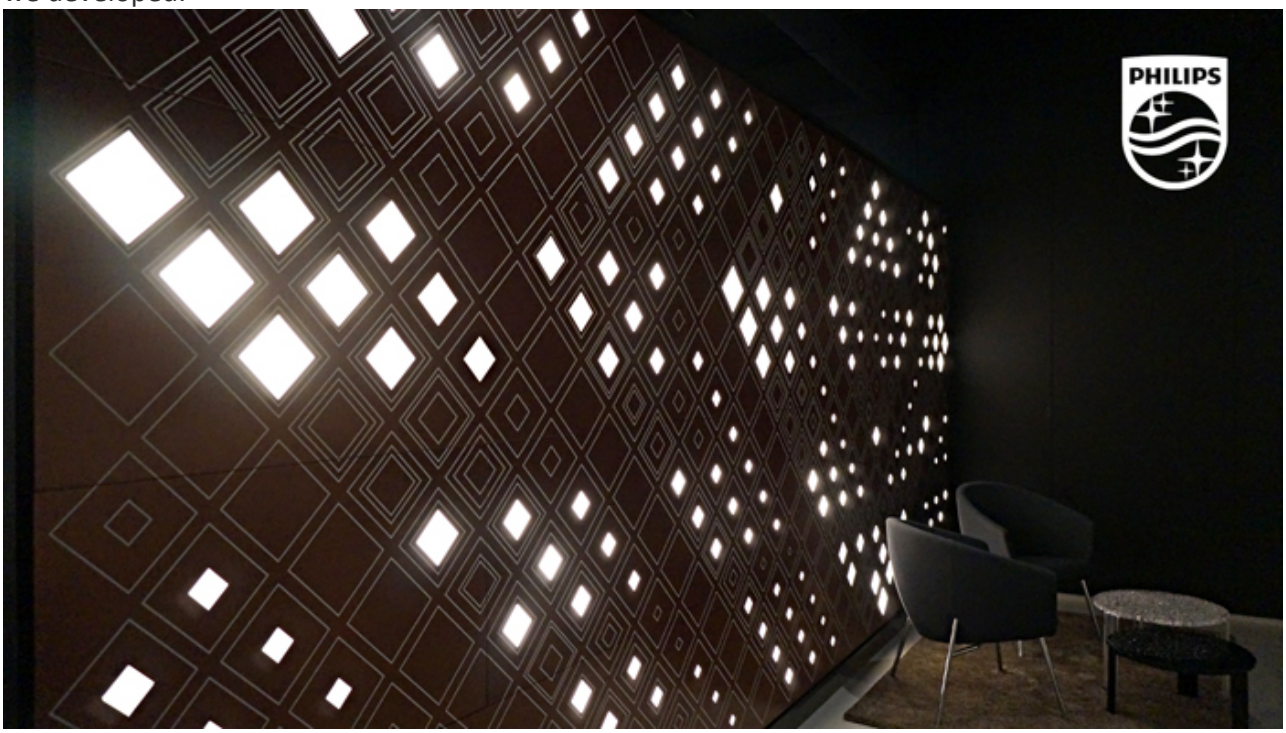
Our System Approach

Integrating lighting features directly into architectural surfaces has long been possible, but has simply been too difficult to implement on all but the most high-end projects. Our goal is to help designers visualize, specify and install embedded lighting features on projects without the typical coordination hassle, cost and schedule risk.

To accomplish this service, we've developed a system of custom-configured architectural panels with a range of creative, integrated lighting features, a wide selection of finishes, and graphic printing. The panels are prefabricated at our factory using digital fabrication processes like CNC laser cutting, CNC guided press-brakes, and UV-cured inkjet printing to enable precise, factory-quality yet with every panel unique. The panels arrive at the construction site ready to install, greatly reducing onsite coordination, installation, etc.

Parametric Design

We've also been experimenting with "parametric" or "generative" design techniques, using Rhino + Grasshopper to develop algorithm-based patterns and panel layouts that generate gorgeous, visually rich patterns simply by adjusting the parametric variables. For example, below is an image of our "Parametric Diamonds" wall, with a video clip of the parametric configurator tool we developed.

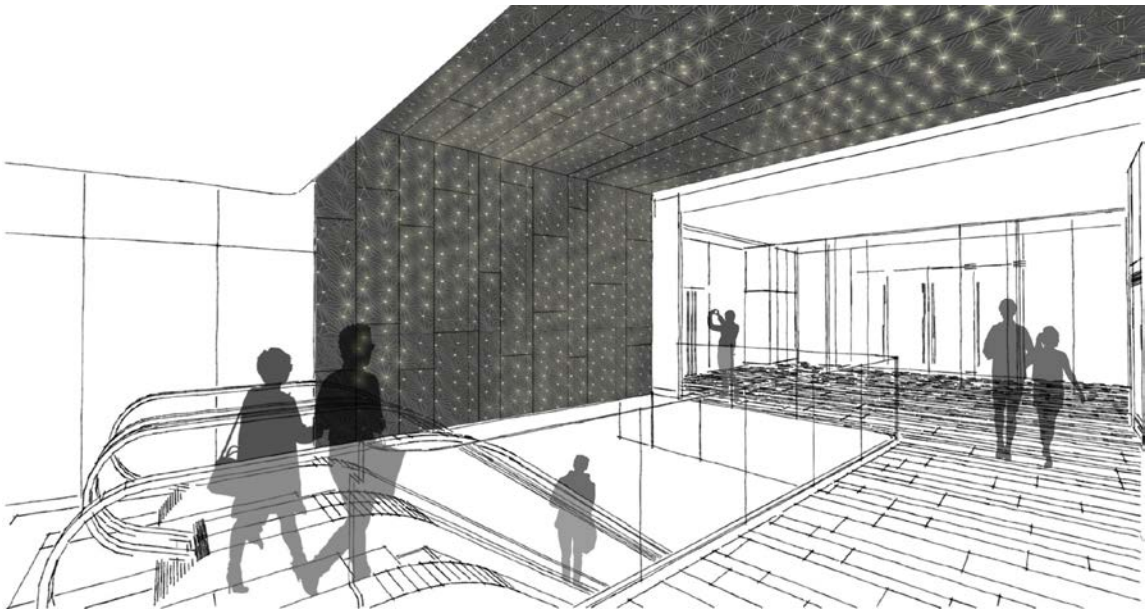


3D Visualizations

Visualization is critical to helping design customers understand the product, and then to help those designers pitch their concepts to their project customers. We've been experimenting with using the Unreal game engine to create stunning, photo-realistic animations and virtual renderings of our walls, such as we show at our Luminous Patterns design website. With all of our product designs now in a live rendering engine, we're developing unique interfaces that allow designers to configure the wall design (light effect, color, pattern, etc.) directly in the virtual model. We can even use VR goggles to let our customers experience our products while walking around in the VR model.

Connected Lighting

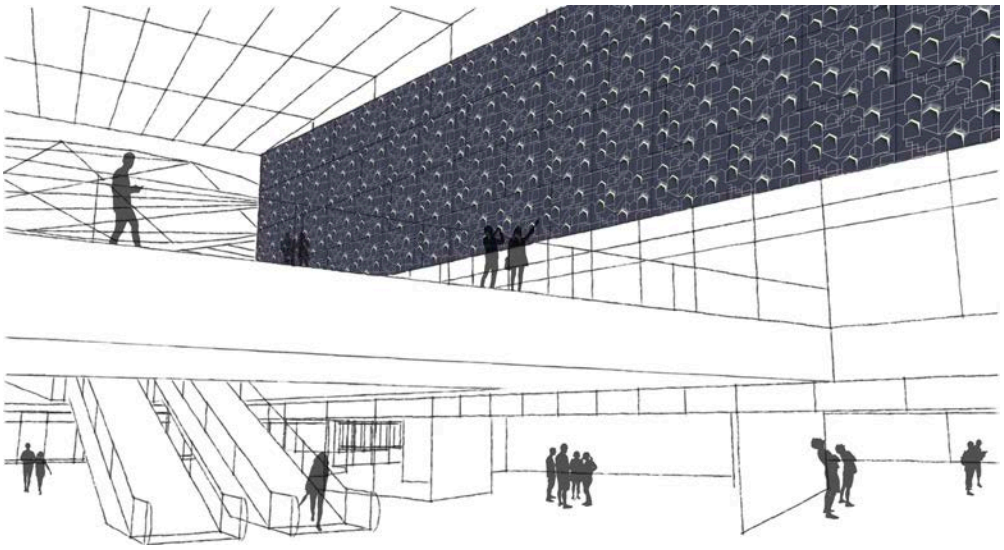
People are mesmerized by the beauty of light in motion; we are hard-wired in our brains to seek visual stimulation to refresh ourselves. Our systems are fully digitally controllable, with every point of light addressable, allowing us custom tailor dynamic animations ranging from the subtle flicker of a candle to sparkling effects to vivid ripples of movement. Our controls technology is based on the robust and well-proven Philips Color Kinetics systems, allowing even for advanced options like cloud-based remote monitoring and programming.



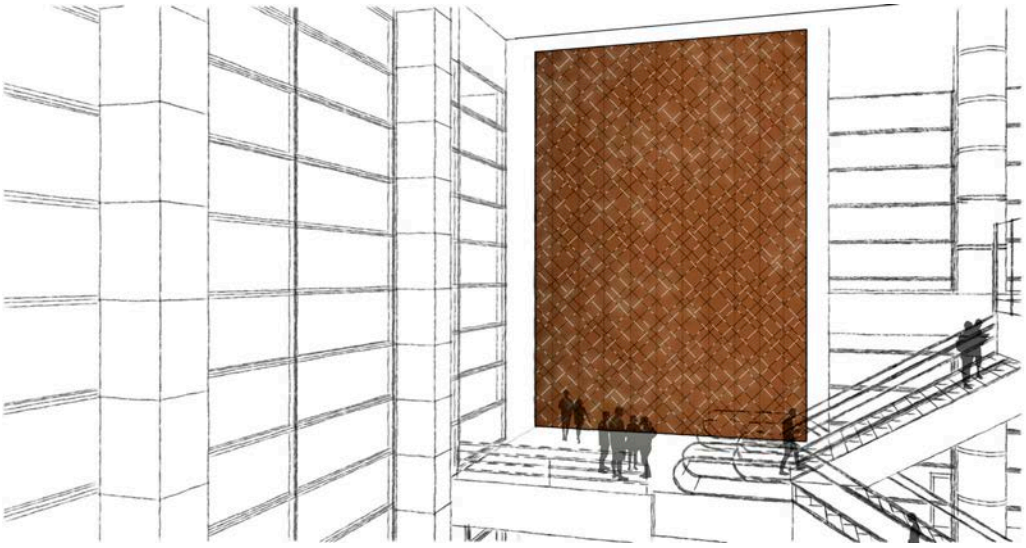
Think Big: How embedded lighting will disrupt traditional architectural surfaces

Fusing LED lighting directly into architectural surfaces promises a host of advances for interior architectural lighting. At first, the installations will be small in scale and many will consider them merely “light art.” But the potential exists to eliminate the concept of lighting “fixtures” altogether, instead using embedded patterns of light across entire ceiling and wall surfaces as the primary light source.

In a previous post I discussed how we designed our Philips Luminous Patterns line to enable new experiences in retail and hospitality applications. But I’ve also been imploring our team, partners and customers to “THINK BIG” – to consider using embedded lighting effects as a complete wall or ceiling surface, especially in big applications like shopping centers, airports, conference centers, etc.

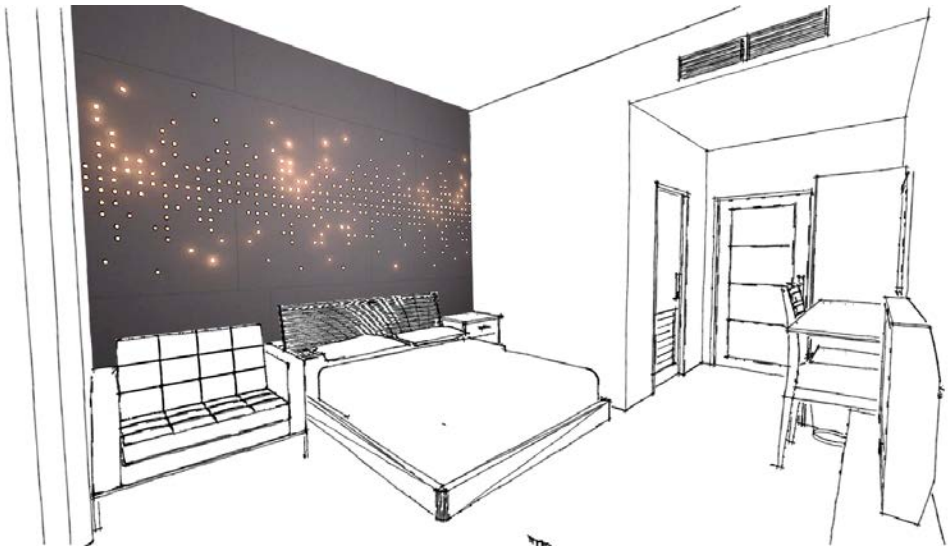


With embedded lighting systems, countless points of light can be easily incorporated in architectural surfaces. Even if each point of light is relatively low output, the multitude of light sources creates a pleasant overall luminosity, a “play of brilliants,” ultimately eliminating the sense that a space is “dark” without necessarily flooding it with lumens. Our interior spaces can be literally wrapped with dazzling new luminous experiences.



Grand spaces especially can be dressed up. Luminous Patterns lends itself well to retrofit applications: If you have a big blank wall ‘o’ gyp, you can easily mount Luminous Patterns onto it for a fresh new look. The dynamic animation and unique optical effects create distinguished lobby spaces, meeting rooms, ballrooms, etc.

Reducing the total project costs of embedded lighting features allows them to scale to more cost-sensitive applications such as restaurant or hospitality roll-outs. Philips Luminous Patterns is custom designed for each project and arrives at a construction site as prefabricated ready-to-hang panels, eliminating many of the fussy coordination issues and hidden costs of lighting features built into custom architectural millwork details.



These concepts are just the “tip of the iceberg” for embedded lighting. There are endless possibilities for creative new light effects and material combinations that exploit the full design potential of LEDs, bringing new lighting experiences to a variety of applications. As the cost of the technology drops and system installations are simplified, interior designers and architects will find themselves routinely selecting embedded lighting solutions like Luminous Patterns as the finished wall or ceiling surface, on projects ranging from cozy intimate spaces to grand mega-projects.

A Baby Snuggy and the Future of Architectural Lighting

Many babies are born with a medical condition called infant jaundice, where the baby's liver is not developed enough yet to process bilirubin, a yellow-tinted pigment of red blood cells. Jaundice is not a harmful condition unless it is left untreated. And the treatment is quite simple: Expose the baby to certain wavelengths of blue light which breaks down the excess bilirubin and allows it to be processed out of the bloodstream.

Now, this is a good case study in the difference between a *lighting specification* and a *lighting design*. The traditional way to give a baby phototherapy is to place the naked, blindfolded baby under a bright blue light. Of course, this is highly traumatic to the new parents, who want to hold and snuggle their newborn, not to see their baby lying under what looks like the hot-lamp at a restaurant.

Several years ago Philips Design and Philips Research proposed using LED lighting combined with “e-textile” technology to make a soft fabric baby snuggy that would wrap the child in light, providing the needed phototherapy while keeping the baby warm and happy (and the parents from freaking out). E-textiles are simply fabrics where some of the woven threads are replaced with conductive wires – and the weaving pattern exposes the wire only where the LED will be placed. In the case of the bilirubin blanket, additional layers of soft translucent fabric diffuse the light and provide the soft, snuggly interior.

E-textiles are one of many amazing new technologies that allow LED lighting to be embedded directly into architectural surfaces and materials. No longer is lighting constrained to the antique notions of *light bulbs* and *fixtures*. The concept of "*embedded lighting*" challenges architectural design itself, because the architectural surfaces will take on a dynamic life of their own, rather than remaining as passive blocks that light shines upon: It is as dramatic a difference as the example of the *baby under the glow-lamp* vs the *baby wrapped in the glowing snuggy*. We now have the potential to wrap ourselves in our architectural environments with healthy, invigorating luminous surfaces.

I recently presented a conference session called "*Embedded Lighting: The Future of Integrating Lighting into Architectural Systems*" at the Neocon 2016 commercial interiors show in Chicago. After showing the image of the Philips Bilirubin Blanket and the LED curtain from Kennedy Violich Architects (image above), I suggested to the interior designers in the audience to imagine filling their architectural spaces with soft, luminous materials that not only provide light, but provide "recipes" of healthy light depending on the time of day or application scenario. Other example concepts I presented included using embedded lighting to create tailored brand experiences, heightening spatial qualities to create romance, tranquility, attraction, etc. The audience was clearly intrigued; material property selection is a key design tool for interior design and to think of light as a material opens up whole new possibilities.

Moving from discrete lighting fixtures to embedded lighting promises advanced new applications of light and lighting controls. With entire surfaces emanating light, digital controls will allow the light to actively "move" around a room, depending on where it is needed; advanced optics integrated into the surfaces may allow the illumination to vary between soft ambient lighting and focused task lighting; and the active needs of the space may be determined automatically, using computer vision systems to dynamically monitor the number of occupants and their locations in a room, daylight levels, etc. Carefully designed scenarios could allow spaces to adapt to wildly different uses throughout a day: a restaurant might be a café in the morning, a co-working office space during the day, a restaurant in the evening, and a club at night. Traditional lighting technologies do not easily adapt to such dynamic and tailored architectural experiences.

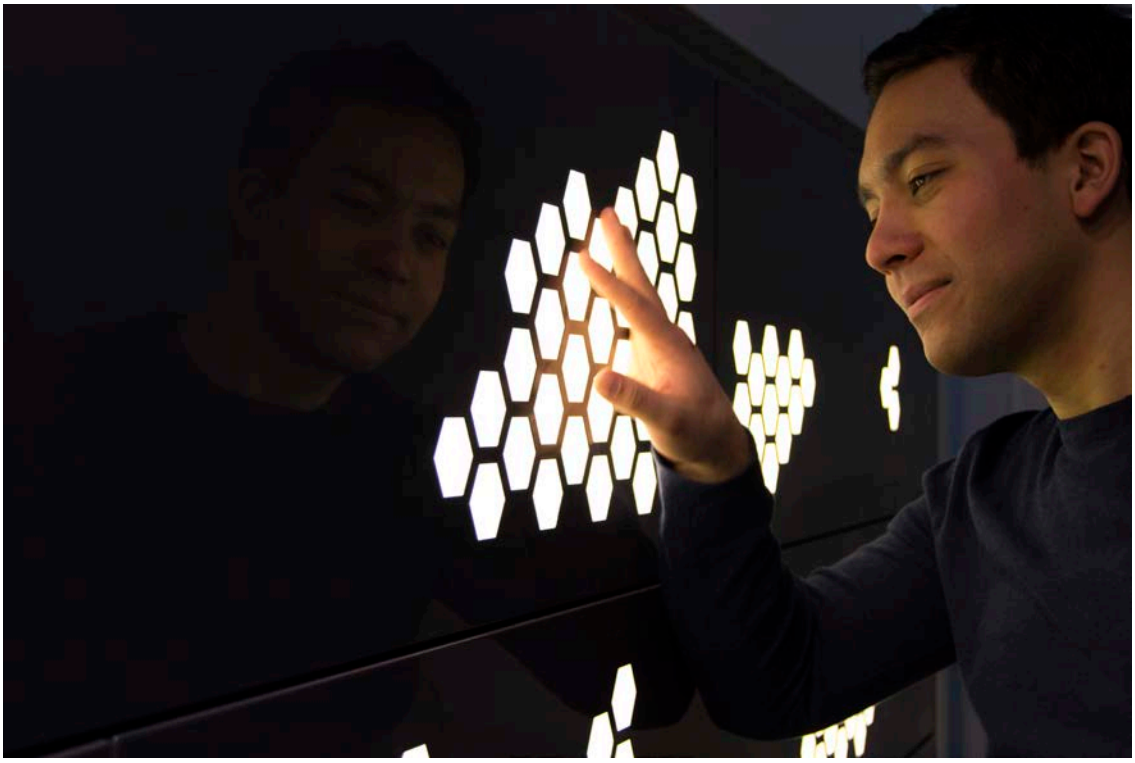
Although the industry is still a ways away from this vision of the future, there are several products on the market moving in this direction. Philips Lighting has been promoting complete solutions for architectural applications with our Luminous Patterns, Luminous Carpets, Luminous Textiles and OneSpace product lines. Philips Color Kinetics offers raw LED fixtures for custom integrations – which have been used in some stunning examples such the Direct TV HQ project by installation artists Electroland (image shown earlier in this post). Tech startups including Cooledge Lighting and DesignLED are pioneering flexible, planar light engines for use in architectural applications, while LG Display, OLEDWorks and others continue to invest in the development of planar and flexible OLED light engines.

There are many experimental technologies in academia and cutting-edge explorations in design studios around the world driving the development of embedded lighting. Check out Diffus Design, Forster Rohner, Zane Berzina, Rogers Research Group, TERASEL, PLACE-IT, Meystyle, High-Low Tech group, or search for "embedded lighting" on my blog Lucept.com.
Architecture itself has moved beyond bland orthogonal boxes into far softer, more fluid, organic forms using innovative material and construction systems (see Frank Gehry, Zaha Hadid, UN Studio, et al). Yet our lighting technologies remain stuck in the world of *hot light bulbs and bent sheet metal*. The future of embedded lighting is rich with innovative potential – fusing light + materials leads to both new architectural forms and applications of architectural lighting.

Create Unique Guest Experiences by Combining Interactive Controls with Embedded Lighting

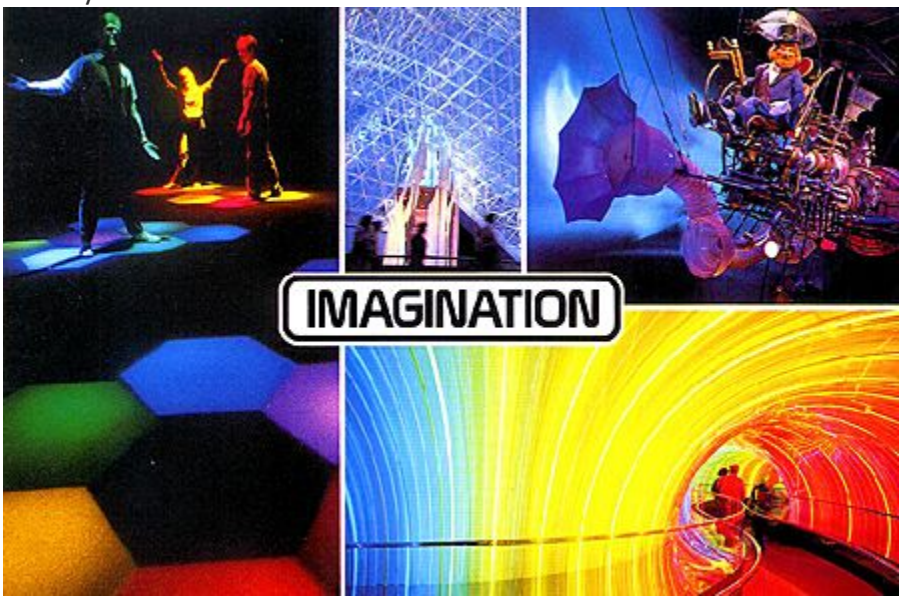
When people experience embedded lighting installations for the first time, their reaction is often to exclaim how exciting it would be if the lighting somehow responded to their presence, if the surface somehow exhibited a “life” of its own.
The concept of interactive lighting – where dynamic lighting or A/V gear responds to a user’s touch, proximity or other activity – has held the promise of creating highly personal and dynamic architectural experiences for several decades, but adoption has been mostly limited to singular art installations.

Let’s consider some use cases where interactive lighting moves from simply being a “party trick” to something that more meaningfully enhances the occupation of a space.



A bit of history…

Examples of interactive lighting exist from the early 1980's. Walt Disney World's EPCOT Center famously had the "Image Works" playground of interactive lighting and A/V exhibits, such as the rainbow tunnel that tracked people's movement with a wave of color or interactive stepping tiles that responded with color and sound. The effects were simplistic, but an absolute delight for literally millions of children.



Other early examples of interactive lighting were found in multi-media music performances, where artists connected their digital MIDI musical instruments directly to trigger lighting effects, to

enhance the performance experience. An excellent example of such early projects can be found at Infusion Systems.
More recently there are many software and hardware solutions available for all kinds of interactive programming, including A/V systems, projection mapping, interactive triggers, lighting, etc. Examples include Troikatronix, Cycling 74, Processing, etc.
Many installation artists have experimented with different forms of interactions and responses. Examples of leading artists in the field today include Jason Bruges Studio, Kollision, Lighting Design Collective, Electroland, Tangible Interactions and Moment Factory.

Me and my shadow…

One of the biggest challenges with interactive lighting is overcoming the most simplistic yet common interactive setup: The "*me and my shadow*" scenario. Many interactive installations do nothing more than mirror someone's presence, expressed such as through live shadow outlines of the person's form, or glowing light blobs, or more decorative effects like sparkles or waves that track along with someone. Whatever style, it is still fundamentally the same thing, a 1-to-1 reflection of your presence. But how does this create any more meaningful impact than staring at your own shadow on a sunny day? The effect doesn't do anything to re-inform or alter the person's activities in the space. After the first razzle-dazzle experience, it is easily ignored.

So why interactive lighting?

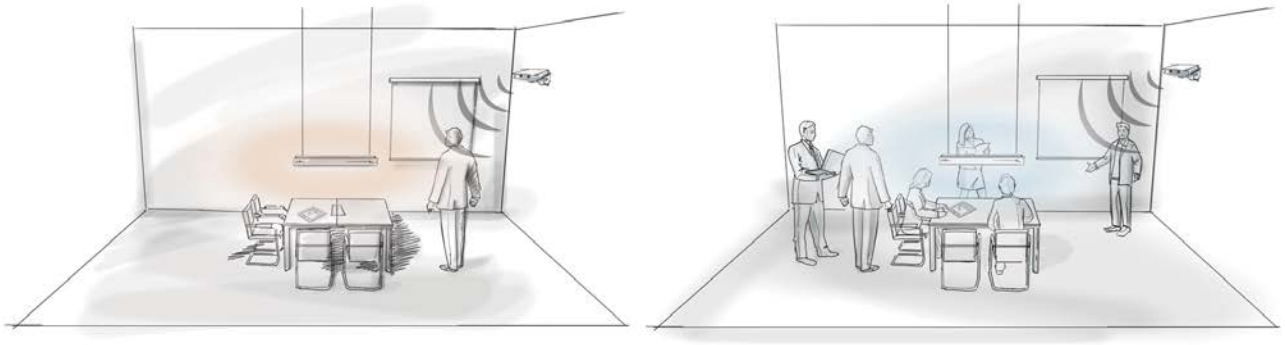
What modalities of interaction will actually enrich an architectural space? There are at least three possibilities:

- Deliver **function**: The correct type of light, at the correct place, at the correct moment in time.
- Deliver **delight**: Enriching human interactions and creating distinct, memorable moments
- Deliver **content**: Architecture can act as a portal to the digital world, providing either ambient or detailed layers of information

These 3 interactions can then be mapped across applications, such as hospitality, retail, office, healthcare, education, public spaces, etc. Within each application, multiple physical interactions can be explored to deliver the 3 primary modalities, including:

- **Touch** (poking, grabbing, twisting, touching, etc.)
- **Occupancy** (passive)
- **Proximity** (zonal, near/far)
- **Tracking** (stereo vision camera)
- **Advanced tracking** (facial recognition and analysis)
- **Identity** (beacons, RFID, near field communication, etc.)

Let's look at some specific examples:

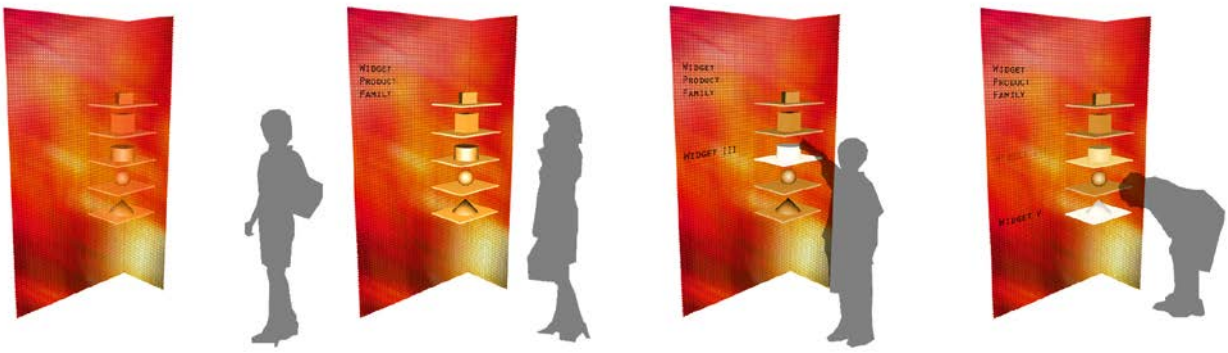


<u>Example 1 – Deliver Function:</u> *Headcount-driven color temperature control*

One example I've published in the past is to use a stereo vision camera to accurately count the number of occupants in a conference room, instead of just passive yes/no occupancy monitoring. When the room has only one or two occupants, the lighting could adjust to a warmer tone and perhaps with a more focused, intimate setting. When the room has many occupants, the tone could go more neutral and the lighting could open up (such as through classical techniques like indirect lighting or wall washing or through more modern concepts of adjusting the surface brightness of embedded lighting features). The point of this is to make the room actively feel more comfortable as it gets more crowded.

Example 2 – Deliver Delight: ***Healthcare environments that provide comfort and distraction***

Philips Healthcare "Ambient Experience" is a design proposition for MRI facilities in clinical settings, combining color changing ambient lighting and digital projections. The goal is to provide some measure of control to nervous patients, such as letting them set their own lighting environments or even play games.



Example 3 – Deliver Content: ***Retail guidance through proximity and touch***

As I detailed in my post on my thesis research from years ago, there is tremendous possibility in using zonal occupancy sensing, proximity sensing and touch in applications like retail to actively help guide people through a search or selection process. The example above is a kiosk that combines a low-res ambient back wall, high-res lettering and content, and color changing glowing shelves.

A world of possibility…

Those are just a few examples. But clearly the combination of the (*3 modalities of interaction)* X (*numerous potential applications)* X *(multiple types of physical interactions)* presents an exciting, creative area for designers. There is a tremendous potential to develop new guest experiences that add useful and meaningful interactivity and that which are distinctly unique.