Animating Glass: Stencil Animation and Smart Materials

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Abstract

Iconic urban neon has been replaced by the sign of our times, the LED screen, with increased light pollution, wasted energy, environmental damage and stress on the populace. Smart Glass is electronic film switchable between transparent and white. Safe, low voltage and highly durable, it's one of the emerging class of reactive materials becoming more commercially available yet relatively unexplored for creative potential.

Smart materials are binary, switchable and often contiguous. These properties align with the first design tool, the stencil, which has revealed potential in nearly every new media from cave drawings to nanotechnology. In Art History, the brush and chisel get all the glory but the lowly stencil preceded both.

Combining the switchable capabilities of Smart Glass with stencils laser cut into frames of animation, a moving image can traverse through physical space, inverting the paradigm of current technologies which present 3D images on 2D surfaces.

The paper will present media-archeological approaches to reveal low-energy dimensional signature alternatives to benefit urban environments by exploring ambient, low-energy display that's more integrated, sustainable and less visually invasive. Poetically, an animated stencil is sequenced light in physical form, like our vanished neon.

Introduction

Reactive Materials have increased in both number and availability but their usage focusses primarily on the environmental benefits. This paper will begin with an overview of reactive materials and how their formal properties can be matched to a design tool that is also binary and contiguous. The stencil has founded creative technologies including painting, 3D design, print, illustration, photography, cinema, computers, copy machines and now nanotechnology. Its rich utility now aligns well with smart materials. Structurally binary, stencils are made of bridges and gaps, a circuit.

As a demonstration of this media-archaeological approach to emerging materials, a prototype design as shown in Figure 1 will be presented that demonstrates how one of these materials, Smart Glass, when coupled with stencil design, can create a new form of dimensional animation. The model inverts the current paradigm of 3D images onto 2D surfaces by creating a flat image that animates through space. This first effort suggests a merging of material and tool that may allow streets, parks or districts to opt for ambient, low-energy signage to offer wayfinding and advertising solutions that are more elegantly part of the designed environment, less aggressive in intensity, and still retain the ability to present information and beauty clearly.

Figure 1. *Animating Glass Prototype 1*, 2018, Artist Name, smart glass and stencil animation, © Artist

Reactive Materials and Behaviors

Smart materials are designed to react to changes in the environment. Reagent categories include electrical, magnetic, optical, thermal, mechanical and chemical. Mediated material behaviors are becoming possible through the use of shape memory alloys, polymers, and dielectrics. Color changes are achievable through dozens of chromic reactive possibilities. While they are indeed binary, on/off, it is their transition of behavioral flux that separates them from digital simulations. [1] These materials are rarely considered for media and their reactive power is harnessed primarily for internal computer electronics and novelty items. [2]

The dynamic effects possible within these materials are pre-digital yet gaining impetus in our evolving post-digital society. MIT's Neri Oxman has begun exploring their architectural applications, enthusiastic about how these behaviors affect the design process, which she refers to as 'Design by Immaculate Conception.' Rather than sourcing materials in service of pre-established plans, the design concept emerges from interactions among matter, energy and force. "Clearly, the question of how to convert and implement some of these ideas in the context of what is today termed responsive environments appears to be a promising and challenging path for the future." [3] Following this thread, certain smart materials when controlled or sequenced may develop into a media itself. By allowing material behavior to be the foundation, the process allows for multiple design trajectories and applications.

Working with a new material inverts the usual design process: the research begins by determining the possibilities inherent in the material, not a pre-conceived final form. As such, the process becomes founded in potentialities. Foregrounding material behaviors in reactive materials is an innovative starting point that will articulate new processes of creative making.

Smart Glass

Smart Glass is a switchable electronic film often used for privacy screens. When on, it is completely transparent, when off, completely white. The material is safe and cool to the touch, shatterproof, extremely low voltage, and long lasting (the original sheet created 30 years ago is still functioning). Like many of the others in the developing class of smart materials, it is becoming more commercially available yet continues to be nearly uncultivated for its creative potential.

Part of this material's appeal is related to the built environment, already a world of glass. However, architectural glass is often obstructed by attached electronic displays that are oddly disjunctive from their hosting objects. Architecture is beginning to explore performance glazes that give glass new powers. The growth industry now rising promises dynamic glasses that are more energy efficient and suggest new aesthetics and displays. [4]

Smart Glass can be laser cut into patterns while still passing enough current to transform from clear to white as visible in Figure 2. However, the cut image must be contiguous; every part must link back to the edges and source of power. The only image possible is a *stencil.*

Figure 2. *Animating Glass Prototype 2*, 2018, Artist Name, smart glass and stencil animation, © Artist

The Lowly Stencil

Stencils are both literally and formally primitive. 35,000 years ago, early man placed his hand on the cold cave walls and then blew a stream of pigment from his mouth through a hollow bone around his fingers. [5] This creative action occurred nearly simultaneously in both Asia and Europe and within a couple centuries, elsewhere around the world. [6] On opposite ends of the planet, the first artists, indeed the first creative acts, all reached for the same tool. [7]

When the Chinese invented paper in 105AD, they quickly saw the commercial opportunities connected with stencil printing. Across six dynasties (221AD-618AD) stencils were used to mass produce images of Buddha and were key to the imagery in the Dunhuang Caves. [8] The Edo period of Japan perfected the art, making delicate stencils, called Katagami, with human hair and threads of silk. Their craftsmanship represents one peak in the history of the design tool enough to be designated as one of the Important Intangible Cultural Properties of Japan. [9] The technique travelled the Silk Road to Europe and in the Middle Ages, stenciling was partnered with woodcuts to create religious illustrated manuscripts. [10]

Miraculously, it never fell into disuse. Even in the 20th Century, stencils became halftones in the comic book industry, illustrations in design books, pochoir in the Art Deco period, moveable type signage for the military and serigraphy for mass-produced commercial fabrics. A number of key 20th Century painters embraced the medium including Warhol, Lichtenstein, Picasso, Miro, Paolozzi, Riley and Matisse. [11] Using the stencil in an urban design context is already present as the weapon of choice for today's leading urban graffiti artists.

The stencil also played a key role in Media Archaeology when used to pass light instead of color. The entire theoretical and formal history of the moving image began with stencils. Plato's Cave metaphorically and wayang kulits literally both used stencils for character and

movement. It was the basis of shadow plays and phantasmagoria that led to early cinema and the foundation of both the first photographs and first projected images. It even proved its utility further as punch cards initiated the computer industry and mimeographs the copy industry; both stencils. Looking to the future, stencils are now also used in nanotechnology. Nano stencils are incredibly thin shadow masks that allow material to be pressed onto a substrate and the only tool possible to view this newly discovered world. [13] Once again, when faced with a new media, practitioners turn to the stencil.

Shared Binary Properties

Today the electronic screen is celebrated for its enabling of complex images, both in detail and illusionary depth. This image complexity has extended to animation which has evolved into a medium that can be immersive, trans-dimensional and responsive due inherently to advances in display technologies. The simple, binary silhouettes of early animation rarely surface anymore and usually only within the context of quaint historical artefacts. The moving image seems to have moved past the stencil.

However, the nascent structures of these stencils were necessary steps towards the expansion of the moving image. At each inceptive moment, they were the only image possible on an emerging media. They formed the first images on every machine but also served as the first steps in demonstrating potential. Languages are established quickly in visual culture.

The stencil's wide utility lies in its core property which synchronizes with smart materials effectively. A web of gap and obstruction, the image itself is a circuit, purely binary. New materials are also binary, on/off switches, only triggered by electricity, temperature flux, vibration, magnetic force, or one of an array of external forces. The stencil has been our gateway to potential in nearly every emerging technology, perhaps now too it can offer direction for our new smart materials.

Spatial Exploration of Animated Images

To demonstrate this pairing of media-archaeological tool and emerging material, a prototype has been designed that explores stencil animation. Combining the switchable capabilities of Smart Glass with stencils laser cut into frames of animation, a moving image can traverse through physical space inverting the paradigm of most current technologies (VR, stereoscopy) which present 3D images on 2D surfaces.

It is unlikely that the screen and the projector are the last stops on the trajectory of the moving image. While true dimensionality is being explored by several research projects in holography and projection mapping, 3-dimensional Virtual Reality is poised to be the next commercial breakthrough. VR, like augmented reality and stereoscopic cinema, presents 3D images on a 2D surface. The prototype inverts this paradigm. Smart Glass' transparency allows for interior frames to be visible. When sequential stencils are computationally switched through spatially-distributed frames, an animated 2D image will travel 3D space as shown in Figure 3**.**

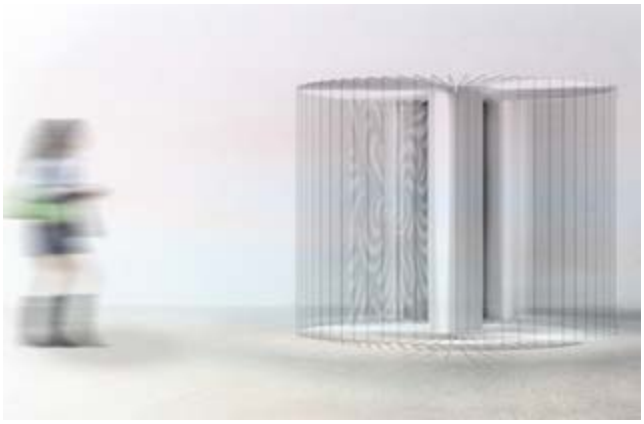

Figure 3. *Animating Glass Prototype 3*, 2018, Artist Name, smart glass and stencil animation, © Artist

By using sequenced stencils and electronically sequenced glass, the flat frame is extended into space and depth. The moving image and its frame move forward together. The effect will be a new type of animation, dimensional without glasses, spatial yet still flat. In addition, the animation created is inherent in the sculptures' materiality, not a separate system of display or projection. Because of this, the images revealed serve a dual purpose of proscenium art and abstraction of the materials' own narrative.

A city's iconic neon signs were also spatially animated forms, playing moving images through a series of tubes being illuminated. Creating their movement through sequenced light, they were old-school electric gifs. Formally, there is an elegiac thread in the prototype in which the progression of lit glass will again provide movement in a physical form. Poetically, an animated stencil is sequenced light in physical form, like our vanished neon.

Media Archaeology and Expanded Cinema also provide context for the creative potential. Early tools are once again providing insight, partially due to a resurgence in emphasizing the physical world. As leading media archaeologist and scholar Erkki Huhtamo writes, "There seems to be a parallel between the emergence of the archaeological art and some changes taking place in the cultural and intellectual ambience. The general framework seems to be the gradual displacement of the 1980's postmodernist discourse in favor of an approach which once again seeks foothold in 'real space and time'." [13]

Conclusion

Display advertising is a USD $540 billion industry, now greater than print [14] and expected to double within 5 years. [15] If this is extended beyond advertising to include electronic displays of news, wayfinding, public service and entertainment, the impact on urban environments is profound. LEDs may be difficult or even impossible to dethrone, but more options could reduce their omnipresence.

Opportunities to symbiotically articulate the uses of new materials into innovative products are rare but important if we are to make the leap from design that simply augments urban space to ideas that integrate and evolve. [16] Instead of attached screens hung externally, a subset of urban display could be structurally assimilated into its environment, inviting more visually aesthetic applications in art, architecture, park design, automotive, fashion and others. Smart Glass can offer alternatives for billboards, commercial signs, public transportation, way-finding, data visualization and other design applications.

While the creative potential of this new material is exciting, it also uses less energy, gives less pollutant, is longer lasting, and safer for public interaction. The signage provides not only more ecologically responsible solutions, but by using these materials in both content and form for creative display reminds the public in a direct, recognizable way the possibilities being explored that improve urban life with minimal harm to the environment.

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Scott Hessels (b. 1958) is an American filmmaker, sculptor and media artist based in Hong Kong. His artworks span different media including film, video, online, music, broadcast, print, kinetic sculpture, and performance. His films have shown internationally and his new media installations have been presented in museum exhibitions focusing on technology as well as those presenting fine arts. His recognitions include patents for developed technologies, references in books and periodicals on new media art, and coverage in cultural media like *Wired* and *Discover*. He is currently an associate professor at The School of Creative Media in City University of Hong Kong and executive producer of the Extreme Environments Program which organizes art/science expeditions to environmentally significant sites.