Luminescence

Electroluminescence as a medium of visual art

The pursuit for and the creation of a piece of art requires, a medium of expression. A medium refers to the materials used to create a work of art and is an integral part of the larger ensemble which is the final piece of art. Mediums offer a means of communicating ideas. Actuating mediums can add an additional layer of visual communication. Manipulating material properties using the scientific method to enhance a visual piece of art can lead to novel ways of visual interaction. Incorporating material science techniques of screen printing, materials doping and 3D printing applications to actuate the natural phenomenon of Electroluminescence, adds this extra layer of visual art to interaction design. That is, introducing the concept of light emitting materials to a branch of design concerning the practice of designing interactive digital products, environments, systems, services and visual instalments. Electroluminescence (EL), addresses the issues of longevity and fragility in smart materials, allowing artists and designers to create visual pieces that produce unique forms of interaction that elicit spontaneous speculation. Artists, engineers and designers consequently can create devices that age gracefully and vigor viewers to appreciate the existence of the current state of ‘things’ while exploring new aesthetic possibilities are brought into interaction design, novel interaction paradigms.

The longevity of any device used by anyone to accomplish a task is mainly affected by the materials used and the subsequent fatigue experienced. The actuation of the materials can be

Figure 1 Nike of Samothrace, a visual piece I painted to explore luminescence

corelated to a materials degradation over time, hence affecting its longevity, endurance and durability. The spontaneous emission of light by a substance that isn't being heated, or Luminescence, is a material property that can be actuated in various ways and is subject to degradation over time. Photoluminescence, a type of luminescence only works when light (photons) are absorbed by the material or in being used for a given duration of time and left to emit its luminous signature after a light source is subtracted from the visual instalment. The figure to the right exhibits a visual piece of art that explores the application of luminescence; however, the visual signature of luminescence cannot be fully captured using a regular camera, revealing a deficiency of traditional luminous inks and paints. Electroluminescence, an alternative type of luminescence, is an optical and electrical phenomenon where a material emits light in response to the passage of an electric current or strong electric field. The act of introducing an external source of stimulus (electric current) triggers the emission of light in such materials. An oddly and annoyingly obvious but prevalent limitation of using these or any material for any application is their ephemerality, that is, their existence (like ours) is only transitory, existing for a finite time interval. Through the process of actuation alongside environmental exposure and chemical degradation, these materials experience short lifespans. Memento Mori, Latin for knowing one's mortality, is the driving philosophy of ephemerality and ephemeral art. These materials bring forth new challenges, confronting us with the questions of longevity, durability and decay. Their ephemeral, dynamic and fragile nature is in direct

opposition to the durability we expect in our products, contrasting our need to keep the nature of existence indefinite.

In his master thesis, “Decay designing ephemeral interactive devices”, Luke Franzke examines the temporality of ephemeral devices. He points out that a growing palette of smart materials are inflowing to the vocabulary of interactive design, altering the nature of how we conceive the topics of longevity, durability, decay and existence itself (Franzke). This offers up the challenge for designers to design devices and products that age gracefully, compelling consumers to ponder the current state of their devices, appreciating them for what they have now. The process of electroluminescence occurs in materials that exhibit light emitting properties which are dependent on the material’s luminous lifetime capacity. This ephemeral aspect to material application is utilized in a design philosophy that depends on the interaction of the device and an observer. Franzke examines questions that probe design obstacles and states “If we take a moment to inventory all our personal electronic devices, we will likely come up with a collaboration of sturdy products in robust aluminum or plastic cases; devices that will stand up to years of use and abuse. But how long do we expect to actually use these devices?” (Franzke). In asking this question, the author seeks to understand the presence of ephemerality and decay and its impact on our relationship with interactive devices. This relates to the overall aesthetics that can be achieved by using electroluminescence as a medium, accentuating ephemeral art practices and the fleeting philosophy of memento mori.

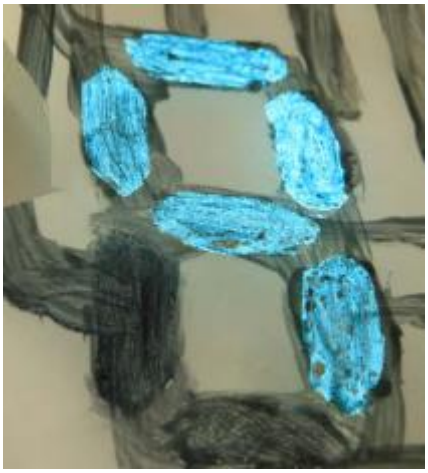

Figure 2 Design incorporating ephemeral smart materials, hand painted on tracing paper

Given that luminescence in general acts as an aesthetic medium, can the question of low cost, new aesthetic mediums be contemplated? What new aesthetic possibilities could the exploration of luminescence bring to interaction design? The concept of a low cost, thin and lightweight device that turns visual information to life through light emission is very interesting and elicits more in-depth scrutiny. This pattern of thought is explored by Erik Mattias and his team in the paper, "Luminescent line art by direct-write patterning". The team presents a direct-writing patterning method of electroluminescent line art using a surface-emissive electrochemical cells (Mattias). Direct writing is an additive manufacturing technique in which a filament (ink) is extruded from a nozzle and offering a low-cost, high manufacturing capability fabrication technique. Currently, there is no technology on the market appears to provide an ideal fit to personalize gadgets in this manner, however there are a few outliers. The team asserts that "The few available examples in the public domain include photo-charged phosphorescent paints that feature a relatively low brightness and short glow time" (Mattias), elucidating, yet again, the ephemeral and temporary nature of these devices, further adding that these devices suffer from "poorly scalable fabrication, inefficient operation, or limited emissive shapes"(Mattias), pointing out more or less a gap between technological capability, limitations and applications.

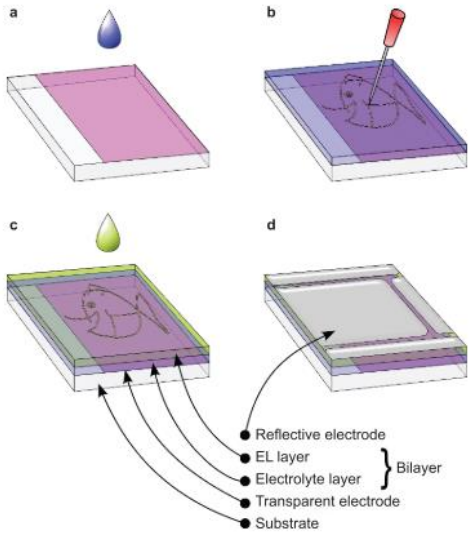

Figure 3 A schematic showing the direct patterning method used by Mattias and his team

In addressing the applicability, capability and limitations of electroluminescence, Ben Krasnow inspects EL paint and the associated multi-channel control circuit that enables the actuation of EL on his You Tube video, "Electroluminescent paint and multi-channel control

circuit". He investigates the technical and practical details of an EL spray paint currently being used in the automotive industry. The item in question that's being reviewed is Lumilor, a product by Darkside scientific Inc. an advanced lighting company that produces luminous paint, owning an electroluminescent (EL) patent on the product. Ben states that the product comes as a combination of inks that are applied in a certain configuration that allows the creation of a "leaky capacitor", capacitors being devices that store electrical energy in an electric field. This mix of inks is sprayed on via an airbrush sequentially to fit a designed material architecture (krasnow). His review encompasses the specific materials used, cost, procedure and operations of the product, leaning towards the applicability spectrum of EL from a consumer standpoint rather than the inks application as a means of elevating aesthetics.

Figure 4 EL paint display on flexible substrate

In the search for the usefulness and applicability of EL, new modes of consumer interactions are being explored. This means that new and creative ways to utilize the material properties are emerging. The novel interactions are offered by electroluminescent dyes, which would make sense if the technology is gradually disseminating down to the average consumers workshop, garage and home-décor. On this matter, labs interested with the evolution of EL are exploring the use of nanoparticle-based inks, thin film conductors, printed electronics and digital fabrication technologies such as inkjet liquid deposition, to print out light-emitting elements that batteries, circuits and sensors. One such lab focused on the interactivity and the evolution of EL

is the University of Pennsylvania's "Penn Design lab" led by Orkan Telhan. Telhan is an interdisciplinary artist, designer, researcher and Assistant Professor of Fine Arts at UPenn whose research focuses on the juncture of design, engineering, and interactivity. An interesting area he is focusing on is the observation of augmented thin film products can harvest energy, display animated graphics, and combine sound play with interactivity. Telhans, "The Eventual" concept combines traditional screen printing with synthetic biology. Designed as a standalone microbial battery that uses bacteria to grow electric current to power up an image that utilizes electroluminescence (Telhan). A special focus is placed on the Geobacteria that forms a biofilm that produces electricity. The intent, as stated by Telhan shows that the research team wanted an object one could place inside a "blade runner" house, insinuating a futuristic applicability (Telhan). The exploration of synthetic biology, a field that fuses biotechnology, computation and electronics, presents another novel application for electroluminescence. Telhan explains that the intent isn't necessarily geared human related research but rather the use of biology as a means of considering possibilities of using living systems in relation to artistic needs, providing another lens to apply the visual aesthetics of luminescence as a medium.

Figure 5 The Eventual, Telhans instalment exploring synthetic biology using EL

Other than the examination of the degree at which technology driven displays can be applied visually, Telhan similarly concentrates on the economical aspects of fabrication techniques as well as the consumer feasibility from a user interface perspective. He focuses on

low-cost printed interfaces where games such as of rock-paper-scissors is turned into an interactive poster that mimics the traditional game. This, as well as composite images made of light emitting elements combines visual information with computationally functional graphics. On his research page "Printed Electronics Research/Teaching", Telhan devises a novel form of interacting with the traditional game of Rock- Paper-Scissors. The page states that the game interacts in the following manner, "Users pick their desired shape and press on it to indicate their choice for the round. The poster then circulates between a rock, paper, and scissors and makes a random decision. At the end of the turn, a scoreboard lights up to indicate the winner. A truce triggers replay" (Telhan). The site goes on to further elaborate that the poster is composed of a composite image made of light emitting elements (EL elements), circuit traces, printed batteries, and sensors that combines the visual information with electrically and computationally functional graphics. This examination of topics provides an insightful look into the current applications of novel forms of media and communication and the perceived impact and interaction with a user. The focus on the role of printed electronics and digital fabrication technologies to facilitate electrically and computationally capable devices is therefore useful in developing an avenue of design philosophy.

Figure 6 Telhan's novel rock-paper-scissors interactive display

In the development of a philosophy for design especially with EL as a visual installment, the methods of approaching manufacturing and fabricating such installments will have to be

taken into consideration. In exploring the viability of methods of fabrication, Michael Hession studies the technique of silk screening and its non-traditional applications focused EL visual design capabilities on his article “This Silk-Screened Art Glows With Electroluminescent Ink”. The method of printing involves a mode of ink transfer (usually a polyester mesh) onto a substrate, except in the areas made impermeable to the ink using a stencil. Hession describes the resultant silk-screened art as an eye-melting artistic experiment, focusing on the development of electroluminescent ink examining its luminosity and opacity where the silk screening occurs on clear plastic sheets allowing for the flexibility of artistic expression. He asserts that the ability to throw microcontrollers and sensors into device lend the technique to a wide array of possibilities, suggesting the levels of design aesthetic that might be possible to attain. His assessment of printing technique and the resultant visual displays illustrates the simplicity of the concept as well as the resultant beauty that stems from the integration of electroluminescence for visual displays.

Through the use of electroluminescence as an application of visual art, artists, engineers and designers can consequently create devices that age gracefully and vigor viewers to appreciate the existence of the current state of ‘things’ while exploring new aesthetic visual possibilities are brought into interaction design and novel interaction paradigms. The ideas of shifting the focus of interactive devices, visual installments and artistic displays from durable products to ephemeral and short-lived devices due to the simple act of device use and actuation leads to the realization of ephemeral, dynamic and fragile devices that are allowed to age and decay (driven by the philosophy of Memento Mori). Because EL technology is a relatively new and young branch in smart electronics, the applicability of the medium is very much open to the users or researcher’s creativity and imagination giving rise to new visually pleasing and aesthetic

possibilities. Likewise, due to the relatively young nature of this technology, designers are given the chance to explore new interaction methods to allow for a new ecosystem in consumer interaction with EL devices. Therefore, the crossroads of materials research and interaction design brings forth a new avenue to explore aspects of ephemerality and decay.

Works Cited

B. Kazan “Luminescent materials for displays: comments on evolution and present status. “Displays, Technology and Applications 6(2):85-94, 1985.0141-9382. Accessed 24 Jan. 2020

Franzke, Luke “Decay designing ephemeral interactive devices.” About, www.enactiveenvironments.com/imagining/decay/. Accessed 1st March.2020

Gray Timmy. “How to Make Electroluminescent (EL) Paint!!” Instructables, 5 Oct. 2017, www.instructables.com/id/How-to-make-Electroluminescent-EL-Paint/. Accessed 29 Feb. 2020

Hession, Michael. “This Silk-Screened Art Glows With Electroluminescent Ink.” Gizmodo, 28 Oct. 2013, gizmodo.com/this-silk-screened-art-glows-with-electroluminescent-in-589610692. Accessed 25 Feb. 2020

Krasnow, Ben. “Electroluminescent paint and multi-channel control circuit.” You Tube, Pergamon, 21 Nov. 2018, www.youtube.com/watch?v=eUUupR-ongs&list=TLPQMDcwMjIwMjBF4evL0tUg-Q&index=178. Accessed 30 Jan. 2020

Lindh, Erik Mattias, et al. “Luminescent Line Art by Direct-Write Patterning.” *Nature News*, Nature Publishing Group, 25 Mar. 2016, www.nature.com/articles/lsa201650. Accessed 2nd March. 2020

Mito, Yusuke, et al. “Photo-Luminescence from Passive Oxide Films on Nickel and Chromium by Photo-Excitation of UV Light.” Science Direct, 6 Nov. 2008, www.sciencedirect.com/science/article.pdf. Accessed 24 Jan. 2020

Orkan Telhan. “Orkan Telhan, The Eventual”, University of Pennsylvania, www.orkantelhan.com/#/eventual/. Accessed 25 Feb. 2020

Orkan Telhan. “Printed Electronics Research/Teaching.”, University of Pennsylvania, www.orkantelhan.com/research#/pe-research/. Accessed 25 Feb. 2020

Robert Withnall. “28.1: Invited paper: Novel, bright, inorganic electroluminescent flexible displays comprising ink jet printed silver back electrodes.” Digest of Technical Papers - SID International Symposium. Blackwell Publishing Ltd, 41397-400. 2010. 0097-966X. Accessed 24 Jan. 2020