

The Education of Synesthetic Interaction Design and the Aesthetics of Engineering and Technology

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Abstract—This paper explores the intersection of education, synesthetic interaction design, and the aesthetics of engineering and technology. The first section delves into the concept of synesthetic interaction design. It examines the merging of sensory modalities to create meaningful and holistic user experiences. By integrating multiple senses, synesthetic interaction design aims to engage users on a deeper emotional and cognitive level, enhancing their overall experience and satisfaction. The second section explores the aesthetic elements in emerging technology and the importance of aesthetics in engineering, examining how sensory integration contribute to the overall experience. The final section of the essay focuses on the implications for education in synesthetic design with emerging engineering and technology. It discusses the need for interdisciplinary approaches in educational curricula, highlighting the significance of integrating design principles, engineering fundamentals, and aesthetics. The author argues that a comprehensive education in these fields should encompass not only technical skills but also a deep understanding of sensory perception, and emotional engagement. By nurturing a holistic and multidisciplinary mindset, future professionals can bridge the gap between engineering and aesthetics, paving the way for innovative.

Keywords—Engaging Undergraduate Students in Research; Multidisciplinary and Transdisciplinary Education; Non-traditional Lab concepts

I. INTRODUCTION: THE AGENCY AND ELEMENTS OF SYNESTHETIC DESIGN

While scientific truth tells us that proteins and nucleic acids are the original forms of life, philosophers seek the sensation of life in and out of matters, the agency, by breaking the dualism between organism and inorganic. The dictionaries always define the word agency as the capacity, condition, or state of acting or of exerting power. When we regard the agency as a possibility of a new form of the object, a combination of time, scene, orientation, relationship, and sequence, then it is an alive web for substances interrelated in complex trajectories.

In the Laozi's philosophical system of Chinese Taoist school, there is a similar concept word called "势| Shi". The 51st chapter of《Tao Te Ching》brings up this Chinese character and people use it from ancient times until today. It is a charming and unique word, but the precise definition of it is arcane and hard to be decisive. The bewildering complexity comes from both the polysemy of hieroglyphic and the obscure information it describes.

It originally describes the energy, propensity, and inherent arrangement of things, and for now, usually be regarded as the internal strength as a kind of 'will'. As a native religion of China, Taoism is a perfect combination of Chinese primitive philosophy and classical aesthetics, resulting in the continuous development of symbols disseminating these aesthetic pursuits.

Around the discussion of Shi, scholars utilize it to analyze the dynamic state of a system. The translation of Shi in the modern physics field is 'Potential'. In terms of kinematic analysis, the potential is the acceleration that changes the state, and in terms of dynamic analysis, the potential is the influence that produces acceleration and thus changes the state of events.

It is then that the ancients came up with an idea to extended Shi to the field of the art research, and devoted it to analyze dynamic perception. A good metaphor will be the white space in Chinese ink paintings. In a piece of ink painting work, white space is of vital importance, it is the breathing room as well as the imagining space. In creating a process, artists will deliberately leave blank to better balance the content and emphasize different areas. The blank is like the pause in a poem, is more powerful than the direct visual information to show all the details. Here the overall atmosphere gives an imagination beyond the painting itself, and Shi works as a tendency that leads our optic nerves to feel the aesthetics, the so-called "nothing wins something".

If one returns to the origin of the term "aesthetics" itself, in Greek the word "αἰσθητική" relates to sense, especially the auditory sense; while in China "美|beauty" is formed by "羊|sheep" and "大|big", namely the taste of big sheep can be called beauty, which is from the taste sense. It's interesting that the pun on the word "taste|味" in both Chinese and English not only represents the gustation to recognize foods, but also the ability and preference to recognize beauty. From foods, sounds, and sights to beauty, pleasure, and consciousness, we experience the process from sense to judgment, from facts to emotions, from innate ability to acquired ability. Same in the artworks, some correspondences relate particular elements to special senses.

One ultimate question: What is it that makes things emerge the beautiful side? The interactions between craft and people, craftsmen and users, even users and users themselves, invariably take the sense as the aesthetic object. Agency is between that dynamic process. How does an agency accumulate and what kind of elements influence that? The following two case studies will analyze more clues on that question.

The first case here is a co-work by Studio Swine and the London fashion brand COS in 2017 named New Spring. The debut of this installation art was in a 1930's obsolete cinema in Milan, followed by the show in Miami, USA, and Shanghai, China. A six-meter-high metal aluminum trunk erects as the main part in the central position of the exhibition space, and extensive 30 branches take a nature arc together with the trunk consist of a strange artificial tree-shaped sculpture. Under the original inspiration of this installation was the Japanese Sakura

Matsuri, the artists create a scene that many smog-contain bubbles dropping down from the end of branches through a special device. (Fig.1)



Fig. 1. New Spring Installation

The mist-filled bubble is a metaphor to the oriental cherry blossoms, more drops forms into the rains, and the punch line of it is the inside smog, with white color and special flower scent, diffused once visitors touch on. If breaking it down to the details, every element incised different sensory dimensions, from the fountain shaped delicate metal tree to the round fragile bubble.

If split up this installation in a functional way, New Spring is a simple combine work of humidifier and bubble machine. But to construct and design it like a movie in the subconscious, the structure, form, color, material, media, and background all need to be coordinated to help with that cinematic effect. The reflective metal and the meticulous craftsmanship give an impression of Milano, the neo-classical archways, the white marbles, modern lamps, and dreamlike scenes. And falling bubbles demonstrate the whole process of growing, blossoming, falling and landing, represents the natural moment of beauty as well as the sadness of decay. The poetic bracts enveloped white water vapor will stay briefly in contact with special texture and fabric, but will immediately burst with touches. The ethereal and ephemeral bubbles also embodied the Japanese aesthetic of wabi-sabi.

Another immersive installation by Studio Swine, likewise, named Infinity Blue (Fig.2). The huge sculpture is a mimic of the shape of cyanobacteria, which is said the smallest and first developed oxygenic photosynthesis creature in the earth. Inside there are 32 vortex engines that periodically send out a circle of smoke representing oxygen, and the natural scent of the smoke, which is mixed with the natural scents of the sea, rocks, earth and forest perfume to mimic the scent in billions of years ago.



Fig. 2. Infinity Blue

The common element between Infinity Blue and New Spring is the natural drops of fog and a dark background. The dense fog appears under the black night sky, and the aesthetic objects begin to shift from a single object to a field. In these multi-sensory projects, if the experience can be analyzed as the appreciation of the interactive objects, then the aesthetic object, in this sense, is the ambiance through dynamic interaction as a whole impression, a complex sense from experiencing.

Another case named WATERLICHT by Dutch artist Daan Roosegaarde(Fig.3). Unlike New Spring and Infinite Blue, Waterlicht uses LEDs and lenses to create a scene with changing flood. Standing in the same height, viewers will see the various shape of the dark blue light, which influenced by the color of the sky, the wind, the rain, or even other viewers. There is no canvas in this artwork, and everything in it, including the color of the sky, the wind, the rain, and the other viewers, together consist of the real-time dynamic light ocean. In the middle of tidal waves, fog again appears as a medium, many artists have tried to shape the fog, for it serves as the ever-running and ever-changing.

From the production of "water" to the production of "the sense of water", the essence of art-making shift from the imitation to the agency. The blue light and water mist used by the designer here are both the imitation of waves and the creation of an agency of wet night.

The word atmosphere came into being a long time ago. From the overall collocation of clothes to the interspersing of colors in interior design, to the large-scale peripheral modeling in architecture, atmosphere emphasizes the power of the whole than that of the individual and the visual sense as the main way to stimulate feelings. In-depth researches on visual communication, on one hand, have raised the social status of visual art, and in other hand, have limited the expressional way of easel art.



Fig. 3. WATERLICHT

II. AESTHETICS OF ENGINEERING AND TECHNOLOGY

As technology increasingly permeates our lives, the design and development of interactive systems have become crucial areas of study. Design, a discipline that integrates sensory modalities to create immersive user experiences, offers a novel approach to engineering education. This section discusses the various techniques and tools used in synesthetic design.

Starting from schools such as the Massachusetts Institute of Technology and New York University, there have more and more institutions incorporated science and technology into the art curriculum. Modern technology has gradually created new vocabularies to make poetry in a new age.

The demarcation between art and information technology was once quite obvious. Traditional information engineers were dedicated to solving technical problems, while traditional art creators were unable to understand how to incorporate coding and other technologies as means of their artistic practice. Early than 1980, there have appeared digital virtual artworks, which paved our way to the combination of art, cyberspace, software, and algorithm. Now the digital art discipline not only using multi-media technology to speed up production but also inciting artists' reflections about the status quo and the future.

The crucial problem lies in the possibility artists and technicians may explore and the possibility of future communication the virtual world could give. To grasp the practical and philosophical implications of this transformation is both the task and the opportunity for contemporary artists.

The thread of historical development, with the development of productivity and the establishment of contacts between people. (Zeng, 2002) As an extension of social living space, cybernetics constitute the abstract web system to explain the abstractness of the social system. From the perspective of cultural communication, cyberspace should not be regarded as a result, but a process of waving, of interaction and co-construction.

Before, the synesthetic art experience is like a field through stimulating different senses brought by objects, but now in addition to the imitation of the real environment, the artistic boundary constantly expanded to the cross bonding effect and the interaction sense brought by technology itself. More than a poem, it is a collage,

with pieces of everyday common as well as remote invasion.

Technology will continue to evolve, and the desire to connect and transcend is always. Exploring the possibilities of the formal and aesthetic aspects of techniques and art is always.

Cybernetics bring more than three dimensions beyond our reality, the agency not only lives a piece of poem but also in visual poetry even in the space poetry. The synesthetic interaction is like producing space poetry, the canvas is no longer a blank paper, your audience is unseen and uncontrolled, through programming and multimedia automation remote control, the medium of communication blended.

Different metaphors and symbols in different dimensions blended, too. From here, the next fantasy scenario woven by digital art and interactive poets may be brewing and generating. It is the spirit of the future world that endows beauty and purity.

Focuses on the complex relationship between people and our natural surroundings, artists always seek expression elements to construct the atmosphere. Natural elements and artificial elements are two categories of classification. In ancient time, nature has the supreme and irresistible power that human depends on to obtain the resources of life: fishing, hunting and farming all necessarily respect and follow the laws of nature. Under this disparity, the inherent aesthetic pattern of natural force was deep-rooted.

III. METHODOLOGY: DESIGN THE LASER- CUTTING SHADOW PLAY PROJECT

The paper aims to explore the integration of synesthetic interaction design principles with engineering and technology aesthetics, using the example of creating a laser cutting shadow play. This methodology outlines the step-by-step approach to developing the shadow play, incorporating synesthetic elements, and leveraging the aesthetics of engineering and technology. It requires students understanding the principles of synesthesia – the cross-sensory perception – and its potential in enhancing user experiences, which guides the design process to evoke multiple sensory responses through visual, auditory, and tactile elements. It can be described as following procedures:

A. Brainstorming and Theme Selection

Identify a theme for the laser cutting shadow play that aligns with the goals of synesthetic interaction design. For instance, the theme could be "Nature's Symphony."

B. Defining Synesthetic Elements

Determine which sensory experiences (e.g., colors, sounds, textures) will be intertwined to create a synesthetic experience. For the chosen theme, consider how visual elements can evoke auditory sensations.

C. Prototyping

Utilize design software to create intricate patterns that evoke the chosen synesthetic experience. Incorporate

elements that resonate with the theme, such as waves or leaves. Create a preliminary prototype using low-fidelity materials. This helps test the shadow casting, refine the design, and assess the synesthetic interaction.

D. Technology and Material Selection

Explore the capabilities of laser cutting technology and materials that can be used. Consider factors like shadow play's intricacy, light penetration, and material durability. Choose materials that can cast intricate shadows and are visually appealing. Consider how different materials interact with light.

E. Audio and Lighting Component

Develop an audio element that complements the visual shadow play. This could involve creating a soothing musical composition that matches the theme. Incorporate LED lighting elements that respond to the audio or user interaction, enhancing the synesthetic experience.

F. Iterative Refinement

Test the prototype with potential users or observers to gather feedback on the synesthetic experience. Refine the design, materials, and interactive elements based on feedback received.

G. Exhibition

Implement refined design elements into the shadow play, ensuring seamless interaction and synesthetic harmony. Present the laser cutting shadow play in an environment that enhances the synesthetic experience, considering factors like lighting and arrangement.

IV. CONCLUSION: EDUCATION COMBINING AESTHETICS AND ENGINEERING

By following this methodology, the paper's authors can effectively demonstrate how synesthetic interaction design principles can be applied to create a laser cutting shadow play that exemplifies the aesthetics of engineering and technology.

Traditionally, engineering has focused primarily on functionality and efficiency, often neglecting the aesthetics of design. The role of aesthetics in fostering emotional connections with technology is significant, which can positively influence user engagement and adoption.

To integrate design principles, engineering fundamentals, and technology, schools need to change the traditional educational settings, which design and engineering are often treated as separate disciplines, and to fully explore the potential of the aesthetics in engineering training. By integrating synesthetic design principles, students can develop a well-rounded understanding of how aesthetics and functionality intersect to create compelling machine and technology. Students need to learn how to empathize with users, understand their needs, and design interactions that resonate with them on an emotional and cognitive level. By considering the user's sensory experience and leveraging the power of synesthetic design, future professionals can create immersive and engaging interactions that enhance user satisfaction.

One notable example that exemplifies how the Bauhaus schools combined aesthetics and engineering is the iconic Wassily Chair, also known as the Model B3 chair. Designed by Marcel Breuer, was inspired by the modernist principles of the Bauhaus movement. It reflects the emphasis on simplicity, functionality, and the innovative use of materials. The chair is a masterful combination of aesthetics and engineering, showcasing the Bauhaus approach to design.

Furthermore, nurturing a holistic and multidisciplinary mindset among students is crucial. Bridging the gap between engineering and aesthetics requires an ability to think beyond traditional disciplinary boundaries and adopt a collaborative approach. Students should be encouraged to work in interdisciplinary teams, fostering an environment where designers, engineers, and other stakeholders can share their expertise and perspectives. This collaborative mindset can lead to innovative solutions that seamlessly blend functionality and aesthetics.

By embracing an interdisciplinary and holistic education, educational institutions can prepare students to become future professionals capable of driving innovation in the field. These professionals will possess a unique combination of technical skills, design thinking, and an understanding of user-centered principles. They will have the capacity to bridge the gap between engineering and aesthetics, paving the way for the development of innovative and captivating interactive systems.

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