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Structural Analysis of Media Façade in Architecture

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Abstract
In this article, media façade in architecture are divided into two parts: physical design and symbolic meaning. The symbolic meaning, which is composed of a series of discursive and presentational symbols, is the manifestation of the physical design.

Key words: Architecture; Media façade; Physical design; Symbolic meaning

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1. INTRODUCTION
The media façade is prescriptive to the final form of the façade in architecture just as grammar and vocabulary are prescriptive to the way and content of language expression. It consists of two parts: physical design and symbolic meaning. The physical design refers to the material and technology used in façade design, such as LED display, façade projection, sensing technology, and mobile device. The symbolic meanings are expressed using both discursive and presentational symbols and are embodied in the symbolic behavioral activities resulted from interactions with people, objects, environment, and the media.

2. THE PHYSICAL ASPECT OF MEDIA FAÇADE

2.1 LED display
A Light Emitting Diode (LED) transforms electricity into colorful lights. It is usually made of chemicals composed of gallium (Ga), arsenic (As), and phosphorus (P) (shown in Figure 1). A LED display often comes in three formats: dot, mesh, and chip-on-board (COB). There are two types of LED display: static and dynamics. Static LED display indicates that the bulbs are lit simultaneously, and vice versa. In terms of color, there are usually three kinds of LEDs: single color, bi-color, and RGB tri-color. In addition, one can use a computer light control system to continuously send signals that contains image or text information to individual rows and columns of a LED display, forming a complete image that can be perceived by the audiences on the screen.

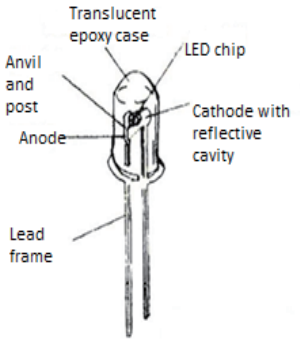


Figure 1
Diagram of a LED bulk

Source: Retrieved from http://www.huafcheng.com

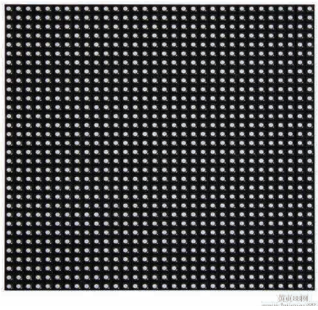


Figure 2
Illustration of a LED matrix
Source: Retrieved from http://www.dianzi.huangye88.com

A LED display with dot format is a dot matrix LED display composed of multiple LEDs or free LED pixel lamps (pixels) installed at certain positions of the building surface (as shown in Figure 2). The manufacturing process and installation are quite simple, and it is highly flexible. It can be easily integrated with the building and can hide under the surface very well so that only the lights emitted are visible. In 2012, SIC Mostovik Architects designed the Ice Dome Bolshoy for the 2014 Winter Olympics in Russia. The surface of the huge dome-shaped building was made of white, reflective aluminum composite material (ACM) with glass and dotted LEDs (shown in Figure 3). Under daylight, the surroundings and light changes are reflected through the smooth surface of ACM. With the assistant of dotted LEDs, the entire architect resembled a colorful version of Faberge Pelican Egg during the night. Easter egg is a significant symbol in traditional Russian religious festivals, especially Easter. It represents health, beauty, strength, wealth, and new life. It is the unity of spirit and soul. Faberge Pelican Egg is crafted by the famous Russian artisan Karl Gustavovich Faberge with gold, diamonds, enamel, jade, and other previous stones and metals for the annual Easter festival of Tsar of Russia. It is a representation of the culture and art of Russia at that time and has become a national heritage. Ice Dome Bolshoy resembled the shape of Faberge Pelican Egg, integrated the dot LEDs display with its surface, and showed the spiritual and cultural traditions of the nation perfectly through this media façade.

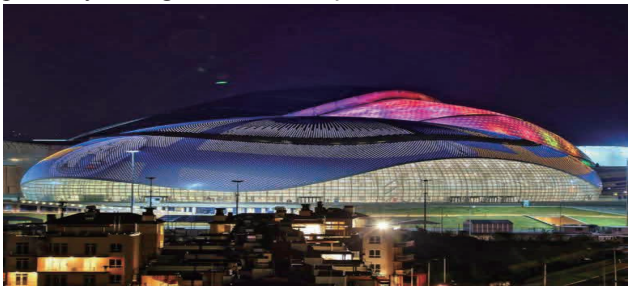


Figure 3
Picture of Ice Dome Bolshoy at night

Source: Retrieved from http://www.mediaarchitecture.org/ice-dom-bolshoy/

Figure 4
Faberge Pelican Egg
Source: Retrieved from http://www.douban.com/note/251607625/

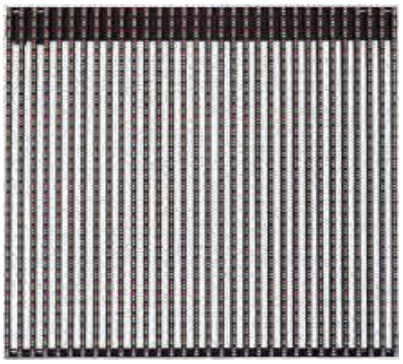


Figure 5
Illustration of a LED mesh

Source: Retrieved from http://www.ledwang.com

Figure 6
Picture of LED Display of National Stadium

Source: Retrieved from http://www.ledinside.cn/qiye/201411233053.html

Mesh LED is a blind-like display composed of multiple LED filaments installed on the building surface at a certain distance interval. Each filament consists of several LED pixels on a flexible strip (see Figure 5). It is lightweight, flexible, with small wind load and easy installation, and has zero effect on the ventilation and lighting of the building. And it is often used for dynamic media façade in architecture.

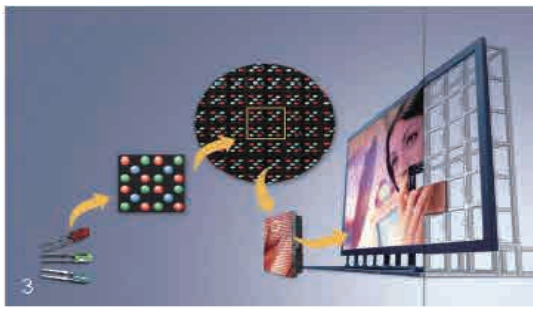
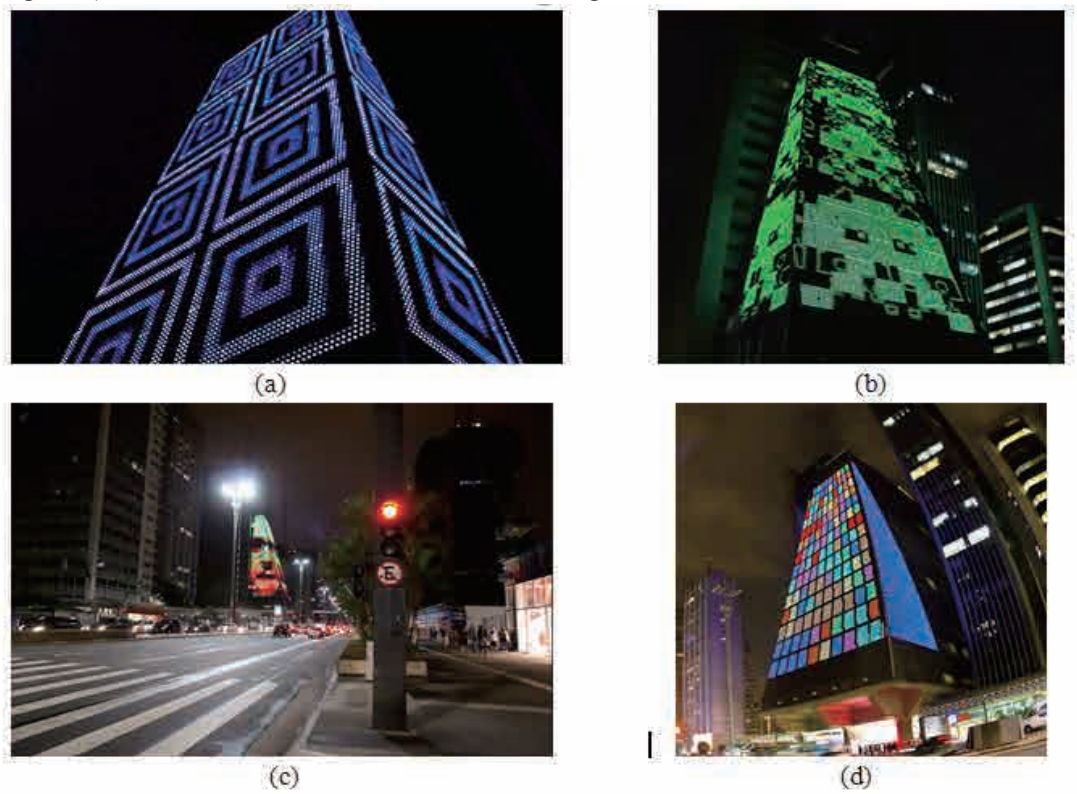


Figure 7
Demonstration of a chip-on-board LED display

Source: X. Zhao, G. Wei, and M. Qiang. Application of LED display in Media Façade Design[J]. Huazhong Architecture, 2011 (05): 74-78.

At the opening ceremony of the Asia-Pacific Economic Cooperation (APEC) on November 10, 2014, the "LED Display on National Stadium" during the Fireworks designed by Leyard Co., Ltd. was the mesh LED display (Figure 6). In order to avoid incidents such as damage and power failure, it adopted the bi-filament LED mesh controlled by independent computer systems. This project, together with lights on the ground, fireworks, and other performances, taking the sky, ocean, and earth as the main theme, conveyed to the world the traditional Chinese cultural and philosophical idea of harmony and coexistence of nature and humankind.

A chip-on-board LED display combines modules composed of individual LED pixels based on a specific size and shape required to form a flat display screen (Figure 7). The COB LED display can be either embedded or integrated onto the building surface. In the former method, the LED display is attached to the exterior of the building, which makes the media façade appear detached from the building and the surrounding. There are too many factors, such as the position and size of the display, that can have a negative impact on this integration. The latter method solved this issue by using the entire building surface as a complete LED screen.



(a) Detailed demonstration of media façade in architecture
(b) Detailed demonstration of media façade in architecture
(c) Detailed demonstration of media façade in architecture
(d) Detailed demonstration of media façade in architecture

Figure 8
Media façade of the Digital Art Gallery at SESI-SP.

Source: Retrieved from http://www.mediaarchitecture.org/sesi-sp-digitial-art-gallery/

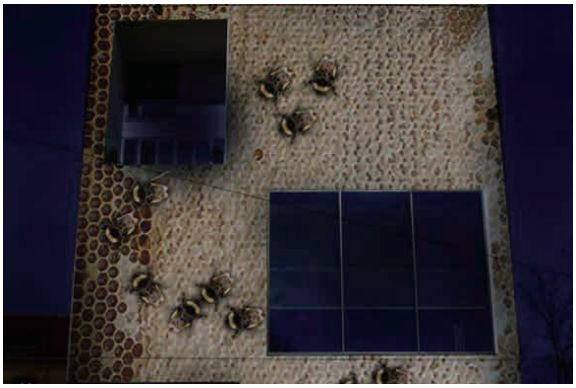
The media façade of the Digital Art Gallery in Sao Paulo, Brazil established in 2012 used a COB LED display composed of 26,000 individual LED matrices (shown in Figure 8). The main purpose of this design is to make the media façade of the Digital Art Gallery the new channel for urban cultural diffusion. It aims to promote the urban residents to think about the harmonious coexistence of human and nature and environmental issues

raised by interactions of the two parties by visualizing and expressing the invisible information and flows of electromagnetic waves, such as changes in urban climate and environment, wind power and strength, flow of ocean waves, and residents' views on the city and environment, as digital visual art and ultimately improve the quality of environment and living standards of the residents. In addition, the media façade of the Digital Art Gallery acts as an open-air showcase for famous art pieces and has become a cultural and art exchange center in Sao Paulo.

2.2 Media Façade Projection

Media façade projection integrates projection technology and recreates the three-dimensional (3D) image of the building based on its original façade. Because of the use of naked eye 3D or 4D vision technology, its visual effects are shocking. Its novel expressions and creative themes, coupled with the unique characteristics due to the tremendous physical volume of the building itself, assigns new meaning and connotation to media façade in architecture.

(a) Detailed demonstration of media façade projection



(b) Detailed demonstration of media façade projection

Figure 9
Picture of projection in the "Human-beeing".

Source: Retrieved from http://www.connectingcities.net/project/human-beeing.

The German art design studio, The Constitute, launched a large-scale architectural projections activity "Human-being" in Liverpool, England, April 2014, in order to promote urban ecological balance. (Details are shown in Figure 9.) Using the rapid decline of bees and the scarcity of beekeepers in urban areas as the theme, this activity elaborates the importance of bees in maintaining urban iconological balance and invokes citizens to learn more about bees, how to protect them, and increase their awareness of urban ecological environment.

2.3 Sensing Technology

Sensing technology refers to the technology used by sensors, which are devices that can sense the prescribed measurement and convert it into a usable signal. It is usually consisted of detectors, sensors, and other components (such as converter and auxiliary power) (shown in Figure 10). The sensing technology can be roughly divided into five types based on the measurement type and usage of sensors: photoelectric sensing, digital sensing, pyroelectric sensing, biological sensing, and intelligent sensing.

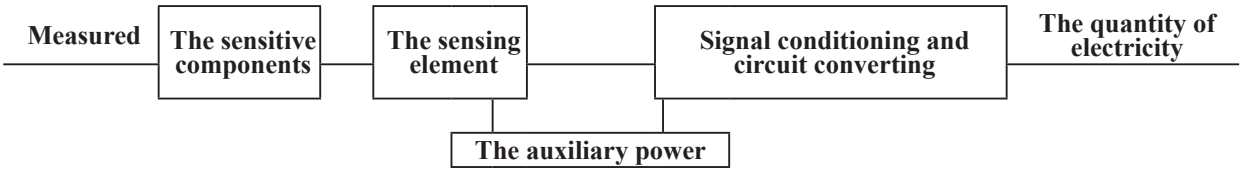
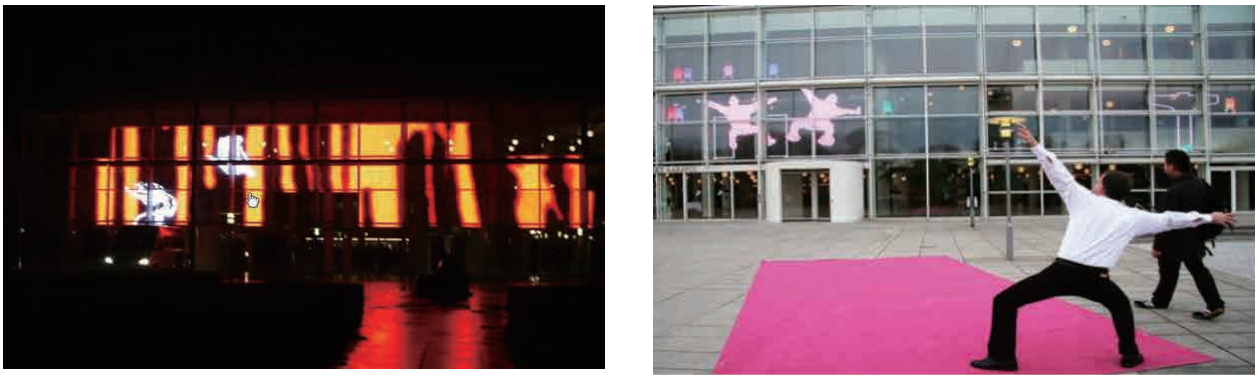


Figure 10
Demonstration of sensors (Zhang & Zhang, 2009).

The experiential media façade of Aarhus Concert Hall in Denmark completed in 2008 used multiple sensors to capture the motion of the crowd. The sensors captured their postures and motion contours and projected them onto the COB LED display, making it become part of the visual image composition of the media façade as occasional symbolic elements. In additions, it allows people to interact with themselves, others, the surroundings, and the building through experiential media façade (shown in Figure 11).



(a) Arhus concert hall (day) (b) Arhus concert hall (Night)

Figure 11
Picture of the experiential media façade of Aarhus Concert Hall in Denmark.
Source: http://www.mediaarchite.org/aarhus-by-light/

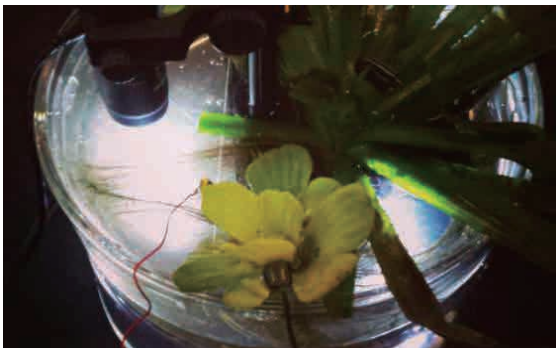
The experiential media façade of Banco de Credito, built in December 2012, Lima, Peru, uses an interactive LED outdoor platform with multi-touch sensors to convey simple and interesting drawings from the citizens onto the building exterior made of mesh LED screens, hoping to evoke the innocent and pure feelings hidden in adults. The media faced of Banco de Credito allows people to break their 'bubbles' and interact emotionally with others through drawing (shown in Figure 12).

(a) Detailed demonstration of media façade in architecture

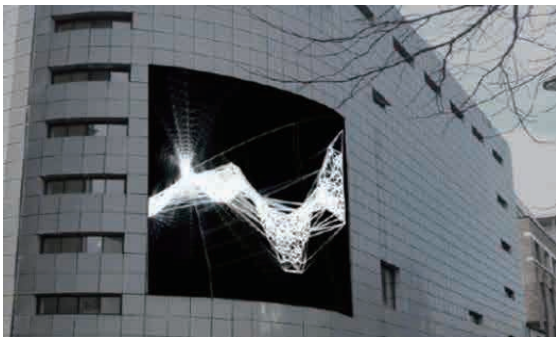
(b) Detailed demonstration of media façade in architecture

Figure 12
Demonstrations of the experiential media façade at Banco de Credito
Source: Retrieved from http://www.mediaarchitecture.org/Affinity/

In September 2014, the art and design lab of British World Wilder Lab used experiential media façade of Medialab Pradode in Madrid, Spain to measure the emotional response of plants to their surroundings through biosensors. It projected the electromagnetive waves generated by interactions between the plants and the environment onto the embedded LED screen. It opens a new perspective for people to reevaluate the plants around them (shown in Figure 13).



(a) Biosensors and plants



(b) Picture of the embedded LED screen of Medialab Pradode

Figure 13
Demonstrations of experiential media façade of Medialab Pradode
Source: Retrieved from http://www.connectingcities.net/project/organic-cinema

2.4 Mobile Devices

A mobile device is a pocketsize handheld computing device that supports touch-screen with small keyboard for input and output of information, such as smart phones, laptops, or portable devices with similar functions. It has a lot of flexibility and interactivity.

In 2010, VR/Urban, a public art media organization in Berlin, Germany, used their own mobile equipment, projection technology, ultra-fast frequency radio, laser positioning, and motion capture to stage the SMSLINGSHOT show at the FACT Media Art Center in Liverpool England. This experiential media façade activity aims to provide local residents with a free interactive platform for communicating and exchanging information with others, expressing their feelings and thoughts about urban life and cultures. Participants first wrote their thoughts into a slingshot-like mobile device, the information will be received by the central computer via UHF radio for processing, and then it will be projected onto the LED screen on the building surface. At the same time, participant's location and action will be located and captured through laser positioning and motion capture technologies. It allows the information to be projected simultaneously with participant's action (shown in Figure 14).

(a) Slingshot-like mobile device designed and made by VR/Urban

(b) Details of the media façade

Figure 14
Demonstrations of experiential media façade of SMSLINGSHOT
Source: Retrieved from http://www.vrurban.org/smslingshot.html

HDOTO, an art organization, launched Connecting Monsters, an experiential interactive activity with media façade at Besiktas Square in Istanbul, Turkey and at Electronic Art Center in Linz, Austria simultaneously in 2013. The purpose is to gather thoughts and ideas from the residents of two cities. Participants can write down their views and feelings about the city on the corresponding mobile App, and the message will be projected onto the LED screen. It allows instant cross-cultural communication and information exchange between residents of the two cities (shown in Figure 15).

(a) Picture of the experiential media façade at Electronic Art Center in Linz, Austria

(b) LED screen at Besiktas Square in Istanbul, Turkey

Figure 15
Demonstrations of experiential media façade of Connecting Monsters

Source: Retrieved from http://www.connectingcities.net/project/connecting-monsters

3. SYMBOLIC MEANING OF MEDIA FAÇADE

3.1 Relation Between Human and Symbols

Susanne K. Langer divides symbols into two types: general and symbolic, and regards the latter as the main feature that distinguishes human from other animals. She thinks the underlying activity of a human mind is the process of transforming spiritual life or emotional experience into symbolic symbols. General symbols are mostly used by animals. They stimulate the conditioned reflex of the brain and trigger commanded behaviors guided by utilitarianism and survival. Unlike the general symbols, humans are the main users of symbolic symbols. Instead of triggering obvious behavioral response, they evoke ideas in minds. Using the yelling signal of a chimpanzee in the distance as an example, animals will immediately take alert and defensive actions; instead, it will cause human to think more about the type, habits, living environment and related stories of chimpanzee. At the same time, development of symbolic thinking and expression of human will not be hindered by changes of the symbols. Instead, human vivifies the material signs (symbols) lives and "makes them speak". Ernst Cassirer once said, "Without this vivifying principle the human world would indeed remain deaf and mute. With this principle, even the world of a deaf, dumb, and blind child can become incomparably broader and richer than the world of the most highly developed animal." Therefore, symbols play an extremely important role in the construction of human's symbolic world and are essence of human minds. Langer used the example of the American writer Helen Keller to prove this point once more. "Miss Helen Keller, bereft of sight and hearing, with the single sense of touch, is capable of living in a wider and richer world than a dog or an ape with all her senses alert."

In the ear of new media, architectural façade is a new channel for urban information communication and diffusion, enabling people to gain a deeper understanding of the urban cultural environment through gathering and exchanging physical and virtual symbols. It helps build a collective consciousness of the city, allows residents to discuss development issues and participant in reforms, and makes the city more vigorous and vivid. Symbolic symbols used in human communication are divided into discursive and presentational symbols according to their differences in perception and response. Both of them are reflections of the empirical meanings of human mind activity, and neither is better than the other. Different analogies, functions, and roles are used in the process of associating symbols with thoughts.

3.2 Discursive Symbols

Discursive symbols represent the rational functions of symbols. Among them, scientific, logic, and language symbols are the most representative ones. Discursive symbols refer to the idea of using standardized, sequential, and logical analogy to describe the nature and characteristics of objects, as well as the compositions and relationships among them, and providing the public a relative subjective truth. In the process of passing information, Langer referred the consistency between the signs embodied in discursive symbols and the actual situation of the external reality is referred to as the objective subject's 'logical projection' to the discursive symbols. They reveal the gradual forming and perfecting processes of a concept or ideological system after logical deductions. For example, language is composed of a series of individual discursive symbols connected by grammatical logic.

Discursive symbols are expressed as permutations and combinations of pixels in media façade. In a COB LED display, the façade is composed of multiple groups of pixel matrices, each of which is formed by pixels that follow certain rules, orders, or standards. Among them, each pixel matrix represents a discursive symbol unit with permanent and universal meaning. People can construct part of the facts we perceived using discursive symbols and gradually express the whole composed of all the facts. In media façade, discursive symbols are mainly applied in promotional files and advertisements videos on LED screens that try to reflect reality. In January 2011, "China National Image Video", produced by the State Council Information Office of China, was displayed on the LED screen of Times Square in New York, USA to publicize the contemporary image of China (shown in Figure 16).

(a) Detail of the media façade at Times Square in New York

(b) Detail of the media façade at Times Square in New York

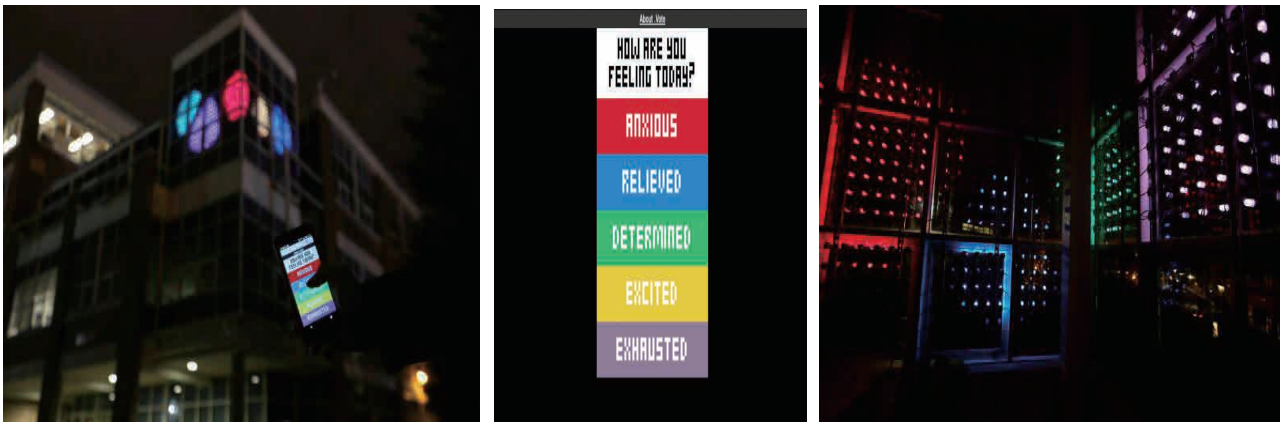
Figure 16
The media façade at Times Square in New York.

Source: Retrieved from http://www.new.xinhuanet.com/world/2011-01/18/

3.3 Presentational Symbols

Due to its use of standardized combinations and arrangements, it is often difficult for discursive symbols to describe complex relationships such as art. This promotes the birth of presentational symbols, which represent the perceptual functions of symbols. Among them, art, religious, and mythological symbols are the most representative ones. Presentational symbols refers to the use of non-discursive analogy to transform all internal ideas, emotions, experiences, and worldview of human into external manifestations that can be perceived by others in a random order. This "articulate but non-discursive form having import without conventional reference, and therefore presenting itself not as a symbol in the ordinary sense, but as a 'significant form', in which the factor of significance is not logically discriminated, but is felt as a quality rather than recognized as a function." Discursive symbols appear as individual components that form an overall concept, and presentational symbols is an entity as a whole, in which components do not carry meanings independently. For example, individual notes that make up music are meaningless. Only through a collective of notes can it gives us emotional experience and enjoyment.

Presentational symbols are usually manifested as a combination of artificial and behavioral presentational symbols in media façade. Artificial presentational symbols are humanized or emotional symbols created on the surface of media façade to express one's inner feelings. Behavioral presentational symbols represent the interactive behaviors with the media façade in order to show one's emotions. These two often appear together in experiential media façade. In May 2014, Dotvot.es was launched using the media façade of the Ryder Center at Northeastern University in Boston, USA, encouraging students to express their emotions on the LED screen. It asked students to take an emotion survey on an App using their smartphones, and results were projected on the LED screen as colored circles. Students' emotions can be analyzed based on the number of colored circles (shown in Figure 17).



(a) Demonstration of media façade of the Ryder Center

(b) Snapshot of the emotion survey on the App

(c) Detail of media façade of the Ryder Center

Figure 17
Pictures of Dotvot.es
Source: Retrieved from http://www.mediaarchitecture.org/dotvot-es/

Presentational symbols are merely manifestations of the inner world of human minds. It helps others understand, examine, and think about the meaning and connotation it tries to convey, but does not carry any information of its authenticity or value. For an abstract painting drawn by an artist, there is no way for us to know the reason behind such creation of the painting or the message it tries to send without discursive information such as the name of the paining, the identity of the artist, date, and painting materials. Therefore, people often use a combination of discursive and presentational symbols in order to communicate efficiently.

CONCLUSION

Langer stated in her book An Introduction to Symbolic Logic, "medium wherein fa form is expressed, its content." Based on this, Marshall McLuhan proposed that the content of one medium is another medium, and the content of a medium is based on a more fundamental medium unit. Medium realizes its own meanings and value through interactions with other mediums. Using media façade as an example, its content is the physical design, the content of physical design is the symbolic meaning, of which the content is a series of discursive and presentational symbols. At the end, the media façade is composed of closely related symbols, and a new environment of cities is gradually formed through information diffusion and communications using these symbols.

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