A Study on the Linear LED Module for Application to Media Art

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Abstract

Background/Objectives: Media art uses expressions using various led lights. The lighting can be divided into points, lines, and planes. Among them, we will analyze the shape of linear leds by studying the shape of linear lights.

Methods/Statistical analysis: The classification according to the physical characteristics of linear leds was divided into the form of pcb, the arrangement of led chips, the control method, and the projection method. We set the items of the led around what is actually applied, and studied the physical limits and aesthetic characteristics of each light.

Findings: By analyzing the physical analysis and aesthetic use of the lighting with linear leds, we extracted the elements that helped when using linear lighting in media art, and attached a representative case. Through this, artists expected to be able to choose reasonable and smart lighting for their works, and attached physical elements of linear led lighting for artists, and studied them to use aesthetic engineering parts. Studying the differences in distance from lighting, how to use them, the choice of led chips, and the projection method will help artists who use led.

Improvements/Applications: The physical and aesthetic analysis of linear leds for media art work using linear led modules is expected to be helpful to artists.

Keywords: Linear led, Led artworks, Light art, Media art, Light Installation.

1. Introduction

LED lighting is divided into three types: dot, line, and surface as shown in Figure 1. In the design of the exterior wall of the building and the landscape lighting, these types of lighting are applied to construct an installed media art such as a media facade. Among them, the LED lighting module having a line shape is very diverse, and various forms have recently been released. The degree of integration of the physical LED chip determines the resolution, and the flexibility of the PCB substrate enables the curve. In addition, the projection of LED light sources directly or indirectly to the audience makes the viewers diversify the atmosphere and the environmental perspective. This paper analyzes the physical types, projection methods, and cases applied to the installed media art.

Figure 1. Classification by type of general LED module

2. Physical Comparison of Linear LEDs

2.1. LED chip placement

The arrangement of the led chip of the color linear led module can be divided into two types[Figure 2]. The first method is to arrange three color RGB chips sequentially to determine the color of all light sources and to use one-chip color led chips. The three-color rgb led chip is lacking in overall color uniformity or expression, but it is stronger than a single chip in terms of brightness[1]. One-chip color led chip is a micro led chip that integrates rgb leds in a small size. One-chip rgb leds usually require four wires for color control, while three-wire rgb leds with built-in led drivers are needed.

Figure 2. 1 chip rgb and 3 chip rgb linear led module.

The placement of the LED chip affects the density of the light source, the projection method, and the distance to the object. First of all, the degree of integration of LED chips that make up the light source affects the uniformity of light and the ability to express information[2]. This point has a greater influence depending on the projection method. If the chip arrangement is made smaller, it has the same structure as the color structure of panels such as electronic displays and TVs. In addition, the type of LED lighting directly viewed by the user is affected by the uniformity or color mixing of scattered light according to the degree of integration of the LED chip. In the case of individually controlled led pixels, the number of led chips per unit area directly affects the resolution. The farther the light source is from the object, the lower the resolution, and the placement and integration of the chip are inversely proportional to the effect. Since this is directly related to the price of lighting, it is necessary to select the placement and integration of the LED chip according to the distance, projection method and information transmission ability. In the case of the electronic display board, the degree of integration is divided according to the distance of neighboring LED chips.

It is divided into the same standard as P3, P5 and P10. The numbers mean that the distance of LED chip is 3mm, 5mm, and 10mm, which is used depending on the distance between the display board and the user. Long-distance display boards, such as concert halls, use low-pitch billboards, and for indoor video billboards, they use high-pitch billboards to secure resolution[3].

The placement and integration of these led chips are also important in linear led, and the artistic expression will always require high resolution and uniform placement, but it is reasonable to choose according to the situation and purpose.

2.2. PCB Types

In the case of the linear LED module, there are a fixed bar shape, a curved shape, and a single or double sided shape[Figure 3]. In the case of a rod type, it is easy to install, and it is easy to connect a plurality of modules, and the curved shape has an advantage of easily forming a flexible curve. Modules using double-sided pcb boards have advantages when linear LEDs are not built in wall lights, but installed in spaces.

Figure 3. PCB Types of Linear LEDs

In the case of fixed bar leds, it is mainly used for sculptures made of straight lines, and is mainly used for low polygon sculptures in three-dimensional form[Figure 4], and is mainly used for representing shapes in 2D. Since the bar pcb has its own hardness, there are many modules that can drive a large number of leds with a small power supply because of the advantages of constructing a form with a small frame and a large amount of current compared to the film type pcb
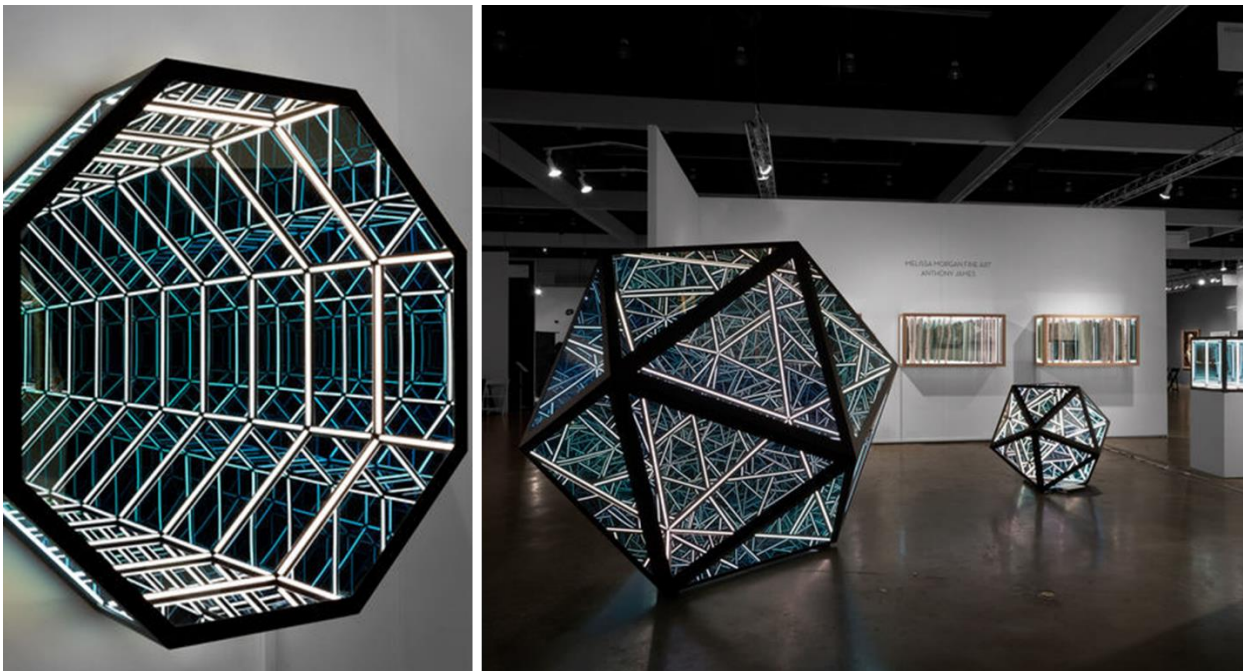

Figure 4. Anthony James's work using fixed bar leds[4]

The curved pcb is widely used because it can produce a free curve. Since the vertical plane is easily bent at the light exiting area and is hard to be bent in the horizontal direction, the case is usually manufactured and produced using light scattering, or in the case of a three-dimensional sculpture, it is often expressed. The pcb, which bends well in the horizontal direction, may be used in the form of a neon led by a silicon type[Figure 5].

Figure 5. Adela Andea's work using curved led neon[5]

2.2. Control Methods

The control method of the linear LED is largely divided into a four-wire method consisting of red, green, blue, and ground, and a built-in driver[Figure 6]. The built-in driver can be controlled by DMX512[6], modified SPI protocol[7], and so on. Addressable pixel drivers, such as popular neopixels[8], use a three-wire system(Vcc, Data, and Ground).
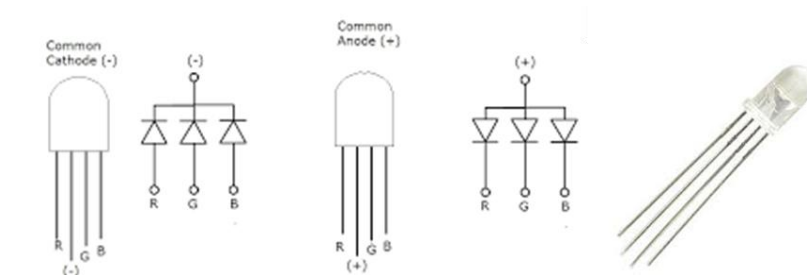

Figure 6. Typical 3 Color LED Types

A typical tricolor color LED is used in four ways, divided into cathode control and anode control. The color changes by adjusting the voltage value of each color, and the number of colors that can be expressed varies according to the resolution of the controller. In general, since 8-bit controllers are used, 256 levels can be expressed for each color, and a total of 16777216 levels of color can be expressed. Recently, chip-type LEDs, LED display

boards, and performance lightings are all manufactured by combining a controller with LED devices of this type. The difference can be divided into the case where the driver is built-in and controlled by the controller for each led and the case where the driver and the controller are combined as a whole. The former can be controlled for each pixel, and the latter can only be controlled overall.
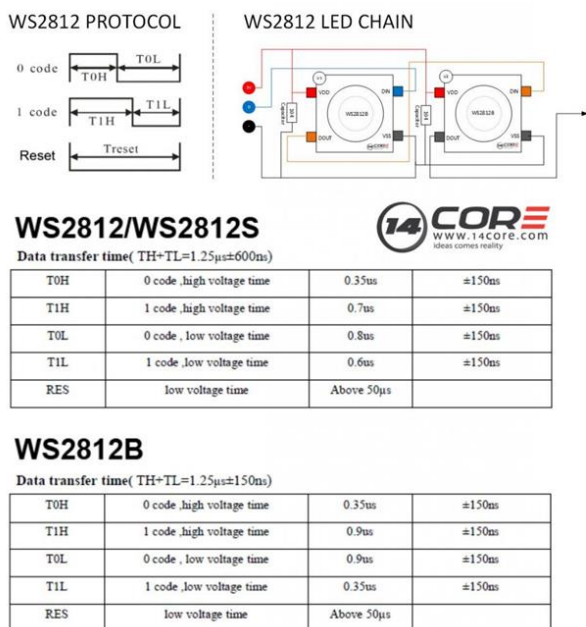

Figure 7. WS2812 as known as NeoPixel

Neopixels (ws2811, ws2812, ws2813) shown in Figure 7 have a driver built into the device so that a single controller can control multiple devices. Such leds are called addressable leds, and there are many LED devices with similar functions on the market. Neopixel is a well-known and familiar led among artists, and is widely used by artists because of its excellent connectivity through the open source hardware platform Arduino and its many educational programs. Since Neopixel has a built-in driver, each led is given an ID number in the order of daisy chaining. This allows the software to control the color and brightness of each led. It is easily accessible through programming, and the shape of the pcb is also convenient to use because it has all the points, lines, faces, and fixed and curved shapes, but it is more expensive than other products. It is controlled using the modified SPI communication protocol and retains the given data once the power is applied because the latch registers store the existing values.

In addition, there is a long history of lighting control protocols. DALI, DMX512, Ethercat, ArtNet, etc. are applied to commercial lighting and are used according to the convenience of wiring, the number of lights to be controlled, the distance between the lights, and the control speed. Artists often use lighting control using the DMX512 and ArtNet, which is easy to control and simple to wire.

3. Projection Ways of Linear LED

In the case of the linear LED lighting module, the light source can be divided into direct light that is directly transmitted to the audience, and indirect light that creates an atmosphere through color effects by projecting onto another subject. In the case of direct light, the light source can be transparently transmitted and the diffuser filter can be used.

Direct light refers to a case in which light from a light source is directly transmitted to a user's eyes. The first thing to notice is the brightness. In some

cases, strong light is used for artistic expression, but you should usually use brightness that is not harmful to your eyes. Light transmitted directly to the eyes is transparent, providing a jewel-like effect. Typical examples include Christmas tree decorations, led sculptures from Luminarie, and tunnels. Since the brightness of the light source is limited, it is often used to increase the degree of integration. It is often installed with optical tools such as transparent lenses or mirrors, and is the most typical method of projecting leds. It also has a filter in front of the led to help scatter light. We do not see the light source, but the color projected onto the surface scattered by the filter. The home's led lighting is almost always attached to the filter, so the user looks at the scattered surface. In the case of linear LEDs, plastic of optical acid material is used or silicon-based scattering filter is attached depending on the degree of integration. In the case of the led neons described above, a silicon-based scattering filter is attached to the user to emphasize the feeling of continuous lines. For a geometric representation of lines, using a led with a scattering filter can be more aesthetic[Figure 8].

Figure 8. Light forest works of bildspur using linear light[9]

Indirect light refers to light that is reflected by another light source and scattered. It is mainly used to create the atmosphere of a space, and is used to create an environment in an installation form having a space such as a media façade[Figure 9], a theme park, and a luminarie. Linear indirect LEDs are often called flood lights and are used for building facades and signs. It can be used to fill a large area in a short distance, and is often used to express the nature of the projected object and the atmosphere of the space.
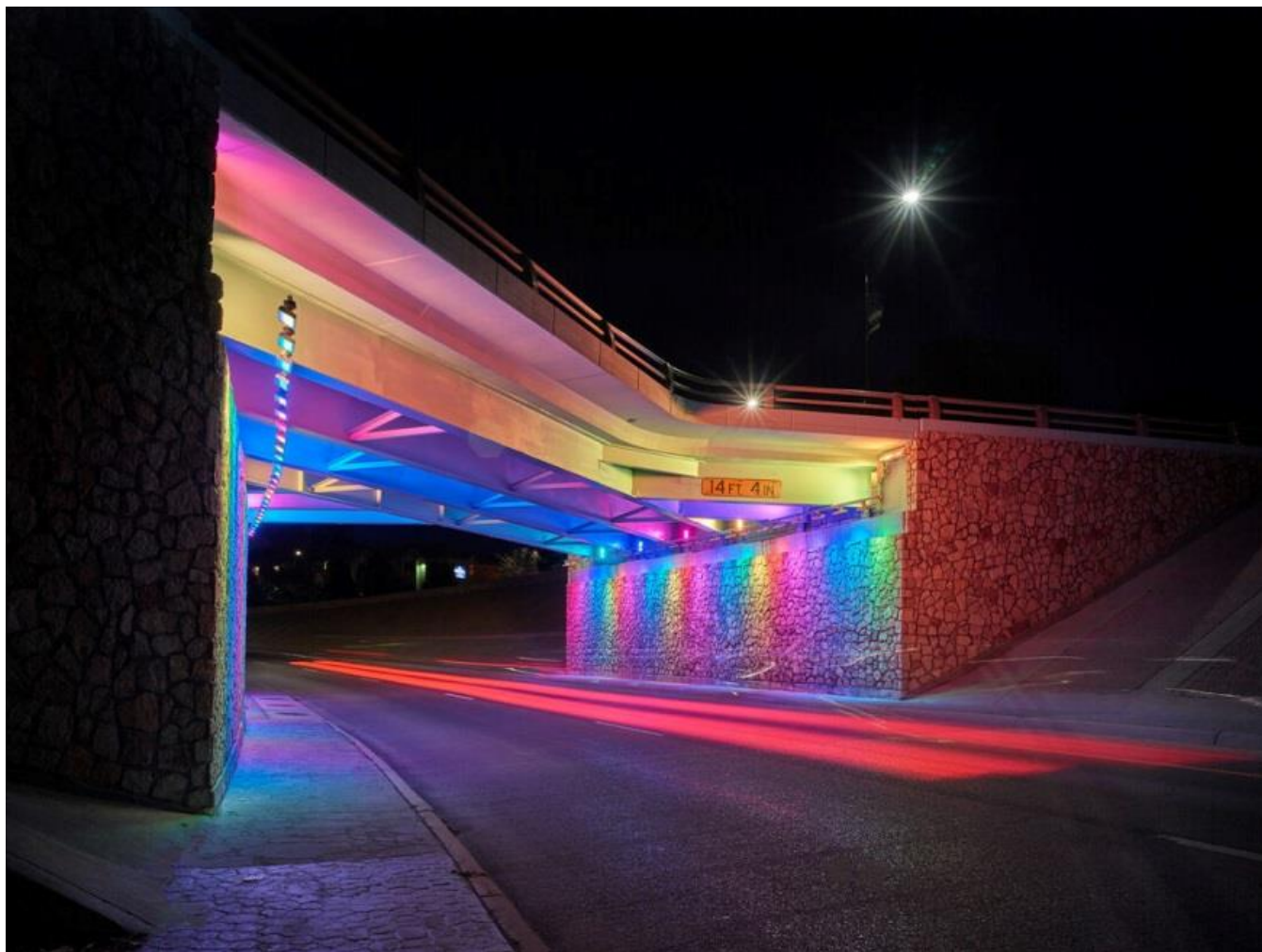
Figure 9. El Paso Passage by Bill FitzGibbons using indirect lighting[10]

4. Conclusion

The arrangement of the color LED chip, the shape of the board, and the control method, which are the physical classification of the linear LED module, were examined, and the differences according to the lighting projection method were analyzed. Through this, the method of applying in various forms in the installation-type new media art was presented. This will help to utilize the linear LED lighting module.

5. Acknowledge

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