Development of a Color Mixer for Mixed-Color Education and Its Outreach Activities

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ABSTRACT

A craft kit of "Color Mixer" was developed to understand easily the principle of reproducing colors while enjoying the craftwork using three LEDs. The composition of the kit, its outreach activity and its educational effect will be presented.

1. INTRODUCTION

"Color" in television and printing is one of important source of information. The basic principle of color reproduction is the combination of basic colors (mixed color)[1]. In self-emissive display like a TV, color reproduction is performed by additive color mixing, whereas in non-self-luminous display like a printing, color reproduction is performed by subtractive color mixing. However, these principles of color reproductions using color mixing are not commonly known to the youth. We developed, therefore, a craft kit so-called "Color Mixer "to understand easily the principle of reproducing colors with mixed color. In this paper, we will present the composition and optical system of the craft kit and its outreach activity and educational effect for education of color reproduction.

2. COMPONENTS AND MAKING PROCESS OF THE COLOR MIXER

A craft kit of color mixer will be presented in this section with describing its components and the making process.

2.1 Electric parts

Electric parts using in the color mixer are shown in Fig.1 which are composed of three LEDs of red, green and blue colors, three variable resisters, a battery case of AA batteries, seven cables, three fixed resisters, breadboard and three AA batteries. Color marks corresponding to LEDs and cable colors are drawn on the breadboard to make it easier to insert them to the holes in the breadboard.

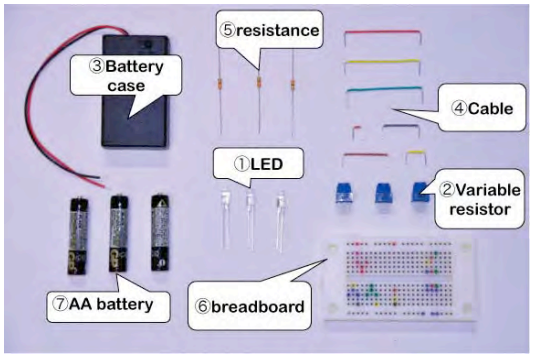

Fig. 1 Electric parts of this craftwork

2.2 Wiring and placing the electric parts properly

The wires are inserting to the holes of the corresponding colors of the breadboard, and electric parts of LEDs, variable resisters, fixed resisters are also wired on the breadboard. The electric circuit for lighting the LEDs is a simple series circuit of the LED and resistances, where +4.5 and zero volts lines are placed in the bottom and upper holes lines respectively in the breadboard. The resistances of the fixed and variable resisters are 33 [Ω] and 10[KΩ] respectively. High luminance and diameter 5mm red LEDs with wide directivity of 60 degrees are used in which typical DC forward current and voltage for it are 70 [mA] and 2.2 [V] respectively, whereas they for the green and blue LEDs are 50 [mA] and 3.3 [V]. The same fixed and variable resisters are used for three color LEDs to make craftwork easily.

2.3 Lighting LEDs to confirm circuit normal operation

The cables from a battery box are connected to the breadboard to confirm the circuit correct as shown in Fig.2. The three LEDs are tightened with a rubber band to form a triangle shape.

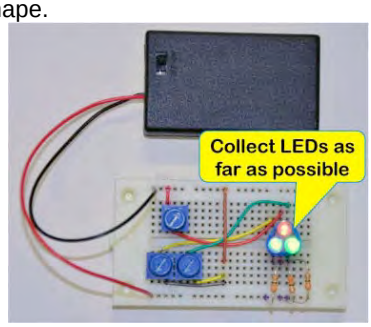

Fig.2. Lighting LEDs to confirm circuit correct

2.4 Assemble frame of LED lantern and combine it with the LED circuit

A large screen sheet made from tracing paper is pasted to a cardboard properly to make a LED lantern that is an outer case of the LED.

The cardboard pasted with the large tracing paper is folded and pasted with double-sided tapes to assemble the LED lantern box. The breadboard with the LED circuit is combined to the lantern box by adhering to its box by tape on the back of the breadboard as being careful that the middle of the three LEDs will be in the middle of the box.

2.5 Pasting top screen to lantern body and completion of the color mixer

The square tracing paper is pasted as the top screen of the lantern body as shown in Fig.3. Push out the mask sheet into one slit in the lantern box and pull it out from the other slit to insert the mask sheet into the body. The completion form of the color mixer is shown in Fig.3, where additive and subtractive color mixings can be confirmed on top screen with moving the mask sheet. Light intensities of three color LEDs are changeable by turning the knobs of variable resistors and it makes color variable on the top screen of the color mixer.

Fig.3. Completion form of color mixer

3. OPTICAL SYSTEM AND BASIC OPERATING PRINCIPLE OF COLOR MIXER

The basic operation principle with its optical system will be presented in this section.

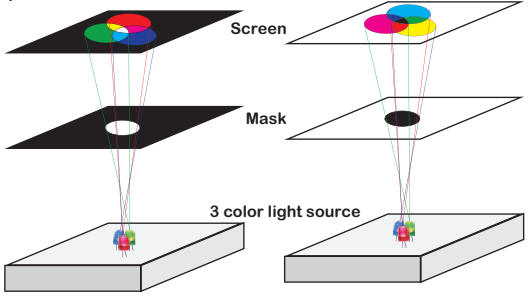

Fig.4. Basic arrangement of the color mixer

The color mixer is basically composed of a light source of three LEDs, a mask, and a top screen made from a translucent tracing paper as shown in Fig.4. For the case of additive color mixing the arrangement of the mixer is drawn in left half of the figure, whereas it is drawn in the right half of the figure in the case of subtractive color mixing. Light from each LED is transmitted or absorbed by the single mask and projected on to the translucent screen.

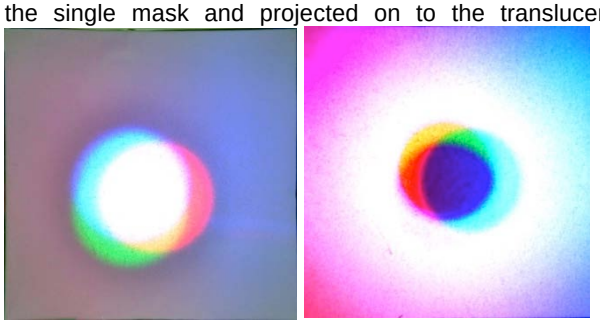

Fig.5. Patterns on the top screen of the color mixer

Patterns obtained on the top screen are shown in Fig.5 in which transparent and absorbing circle masks are corresponding to additive and subtractive color mixings, respectively. The feature of this color mixer is in easily obtaining the patterns for the both case by merely sliding the mask.

4. OUTREACH ACTIVITIES

Outreach activities from 2014 to 2018 years using the color mixer are summarized in Table 1. The most active and longest activity was the science fair where many young people from junior high school to high school students participated to make the color mixer during about 20 minutes. Many participants enjoyed in making the color mixer very much and learned how to reproduce colors on a TV and a printing, it became clear from their questionnaire results.

Table 1. Summary of outreach activities

Event name and its venue	Target participants	The number of participants
Science fair for Kanagawa Teenagers, Yokohama Kanagawa Japan	Middle and high school students and their parents	190 (July 2014) 200 (July 2015) 200 (July 2016) 160 (July 2017) 168 (July 2018)
Wakuwaku(Exciting) kougei land, Atsugi Kanagawa Japan	Elementary and junior high school students and their parents	50 (July 2014) 21 (July 2018) (Excluding parents)
Experience workshop to create color, Atsugi Kanagawa Japan	Elementary and junior high school students and their parents	50 (October 2017) (Excluding parents)

5. CONCLUSIONS

A color mixer for education of color mixing has been developed and its components, the making process, the basic principle of operation, and so on have been described. Outreach activities using the color mixer were also mentioned. It is important for children to learn and think about how to reproduce colors while making the craft kit of color mixer. It is also useful for their lives, so we need to continue the outreach activity in the future.

Its details with the educational effect and demonstration will be presented on site. This work was supported by “FY2016 MEXT Private University Research Branding Project”.

6. REFERENCES

[1] Hunt R. W. G., [The reproduction of Colour Sixth Edition], John Wiley & Sons Ltd, Chichester, 9-30(2004).