Dynamic lighting sign system for way-finding by people with low vision

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Dynamic Lighting Sign System for Way-Finding by People with Low Vision

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1 Introduction

Intelligibility is a prerequisite of signs indicating a certain course. In line with this basis, many signs have been developed over the years. For example, pictograms help travellers follow the course easily because it is intended that travellers comprehend the signs just by looking.

Despite their efficiency, pictograms are not always useful for people with low vision. First, those people have difficulty in paying attention to signs because they are static. Second, they must have knowledge about signs; that is, they are required to make out what the signs mean. And third, not every sign is legible due to their small size.

As an alternative, the motion of light signs is considered to be more effective than static signs on the ground that:

1. It is noted that information on the motion of light (referred as optic flow) is specified intuitively. James J. Gibson, a pioneer of ecological psychology, demonstrated that relative optical flow had rich information on the relationship between people and environment (Gibson, 1955; 1979/1986). For instance, when light sign moves, this motion can provide information that leads people to the same direction.

2. The optic flow will draw attention from people with low vision, because eyes are sensitive to the motion of an object regardless of the eyesight. It is also valid in the case that the motion is projected in the peripheral field.

In our development study, we are going to design the new sign system of showing ways to people with low vision, by using optical flow. We will also show the usefulness of this system.

2 System Architecture

The architecture of developed dynamic lighting sign (DLS) system is shown in Fig.1. The lighting unit

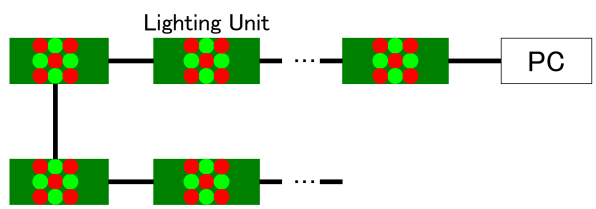

Figure 1: System architecture

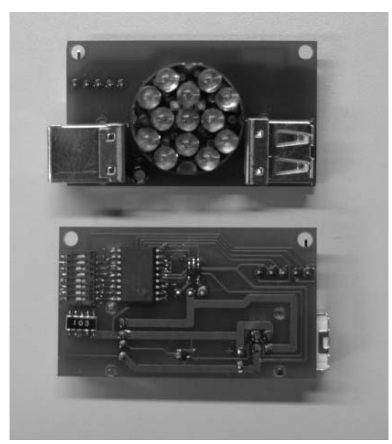

Figure 2: Lighting unit

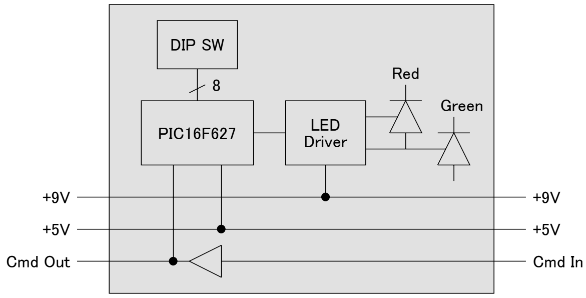

Figure 3: Structure of lighting unit

as shown in Fig.2 with two colors LED are connected in chain so as to form the line of light, and finally to the controller PC. Both the color and the light pattern are controlled by PC.

The structure of the lighting unit is shown in Fig.3. The lighting unit has a micro controller (Microchip PIC16F627) for control, and receives the lighting command of two bytes on asynchronous serial interface compatible with RS232C. The ID number can be set for each lighting unit in order to control each lighting unit independently from the controller PC using the two byes of lighting command. The received lighting command are buffered to passed to the next lighting unit so as to form a broad cast command message network from controller PC to all the lighting unit.

3 Preliminary Experiment

3.1 Time difference of light blink

We conducted a preliminary experiment to determine parameters of DLS system, which enables people with low vision to aware of optic flow by lights blinking. In this experiment, two males and two females with normal sight were participated.

12 stimuli of each LED blink was given to the subjects; starting with 20 ms, the time difference increases by 5ms, up to with 80ms. The trials was given in both the ascending (20ms through 80ms) and descending (80ms through 20ms) order. As for the former order, the standard stimulus was set to 20ms, and the other 11 stimuli were given as its comparative stimuli. As for the latter order, the standard stimulus was set to 80ms, and the other 11 stimuli were given as its comparative stimuli. There were 2 trials for each order with their comparative stimuli. Hence, there were 22 trials in one series of stimulus presentation. In addition, two conditions of lighting stimuli were presented: simultaneous blinks of six LEDs and simultaneous blinks of nine LEDs.

Subjects, wearing the Bangerter filter glasses1, sat down with a distance of 3 meters from the DLS system. They were asked to watch the standard stimulus and comparative stimuli sequentially, and to rate each comparative stimulus in five levels, from the maximum (Level 5), 'appearing absolute flow of light', to the minimum (Level 1), 'never appearing flow of light'.

Table 1: Averages of rating levels in lighting interval experiment

time diff.	6 LEDs	9 LEDs
20ms	14.8	15.8
25ms	15.5	16.0
30ms	14.8	15.5
35ms	13.5	15.2
40ms	12.8	14.2
45ms	12.0	13.0
50ms	11.2	11.5
55ms	10.0	11.0
60ms	9.0	10.0
65ms	9.2	9.0
70ms	8.8	8.0
75ms	9.2	8.0
80ms	8.2	8.0

Table 1 shows averages of total rating levels for four subjects for both cases of six LEDs and nine LEDs.

These results indicated that , on average, all subjects rated the 25ms time difference highest in both series of time difference. Therefore, we determined 25ms as the parameter of the time difference in both conditions of six and nine simultaneous lighting stimuli conditions.

3.2 Inter-LED interval

The optic texture gradient possibly gives perceivers the clue for perceiving the depth (Gibson, 1979/1986). Based on Gibson's theory, it is thought that depth perception is influenced by the change of LEDs' interval. The aim of this second experiment was to determine the most effective inter-LED interval for perceiving the flow of light.

The subjects of the experiment of 'Time difference of light blink' described above were also participated in this experiment.

With the same experimental setting, the two conditions were modified. On the one hand, 'Normal texture condition' provided the same intervals among LEDs. Under this condition, the subjects perceived the depth in perspective, thanks to the right texture gradient. On the other hand, 'Emphasised texture condition' narrowed the intervals among LEDs by degrees, as the distance between LEDs and the subject became further. Here the virtual depth is magnified by emphasising the texture gradient.

The subjects, wearing the same glasses used for the previous experiment, were asked to watch the two lighting stimuli (same as the previous experiment), and to judge which light stimuli was better as a dynamic sign of signalling direction. The result of this experiment showed that 'Normal texture condition' was more adequate than 'Emphasised texture condition' in 88% of the trials.

3.3 LED color

The experiment of evaluating the best color of blinking LEDs were also carried out. With the same experimental setting, the eight types of color of blinking LEDs were used. The lighting unit has two colors of LED; red and green, and can control the intensity of each color for eight levels. The ratio of two colors were set eight types of color; red:green = 7:0, 6:1, 5:2, ..., and 0:7. (7:0 represents the true red, and 0:7 represents the true green.)

Three of the four subjects indicated that the ratio of 7:0 was the best color for light, while one subject indicated that the ratio of 6:1 was the best. According to this result, the desired color of blinking light for dynamic lighting sign (DLS) is 'red'.

4 Evaluation experiment

We obtained the suitable parameters of blinking light using developed system based on the preliminary experiments described above. We are planning to carry out the evaluation experiment of the developed DLS system for way-finding, and the results and discussions will be reported in our paper.

5 Conclusions

We proposed and designed the DLS system for way-finding by people with low vision, and described the preliminary experiments and their results. The evaluation and discussion on the experiment of way-finding using the developed system will be reported in our paper.

References

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[2] Gibson, J. J. (1979/1986). The Ecological Approach to Visual Perception. Hillsdale, NJ: Lawrence Erlbaum Associates, Inc.