The support system for the night blindness student using night vision camera

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Abstract. Entering into a dark place, a normal person loses a sight at first, but recovers the sight for a while. This is an adaptation to darkness. The dark adaptation impairment is that the sight is never recovered. A night blindness is one of the visual impairments, the dark adaptation impairment. The night blindness students in university feel inconvenient. The teacher of university makes the room dark a little, when using a projector. Then the night blindness students loses their sight, therefore they become hard to follow the lecture. Our support system is consisted of a camera and a monitor displays. A support system captures classroom and displays image data brightly for the night blindness student. Our previous support system used a normal camera. However, the normal camera did not work well at dark place. Therefore, we replace the camera by a night vision camera. The night vision camera can works well also under small light. We will present the support system.

Keywords: the night blindness, the support system, the visually impaired person, night vision camera.

1. INTRODUCTION

In recent years, universities and vocational schools are opened for visually impaired persons as a place where they study with normal persons. For blindness and weak eyesight students, Braille points and enlarged characters are used as support tools. However, there is no support for the night blindness students. When we use a projector in a classroom, we turn off room lights. Under such situation, a screen is bright and tops of desks are dark, and the night blindness students will be troubled. We constructed the system by which the night blindness students can attend like normal students. Our previous support system used a normal camera, however, the normal camera did not work well at dark place. Therefore, we replace the normal camera by a night vision camera. The night vision camera can works well also under small light. We will present the support system.

2. THE NIGHT VISION CAMERA

We used the high sensitivity camera and far-infrared camera in a night vision camera for the experiment. In the following, we explain these two types of cameras.

2.1 The night vision camera

The night vision camera is one of the security cameras or surveillance cameras. There are a few types of the night vision cameras, one captures images by raising sensitivities, one does through the infrared, and so on. The high sensitive camera can capture images in dark place by enlarging lens and/or imaging devices, multiplying photo or reducing noises. The infrared camera captures the infrared. The infrared is invisible electromagnetic wave and is classified into two zones, the near and the far infrared, with respect to the wavelength or the frequency. The near infrared, of which wavelength is from about 0.75 to 1.4 x 10^{-6} m, locates just outside of the visible and is utilized as cameras, communications, remote controls, a vein attestation, etc. The far infrared, of which wavelength is from about 15 to 1,000 x 10^{-6} m, is so called the electromagnetic wave of the temperature region. By measuring the wavelength of such infrared, we can detect the temperature, and therefore, we can detect objects.

2.2 Performance

Two night vision cameras used this time are a far-infrared camera and a high sensitivity camera. The far-infrared camera is the experimental model under development of JVC Kenwood. Detail specification is not specified.

The specification of the high sensitive camera is given in the Table 1. This can work under illumination of 0.05 lx and provides the full HD vision. Appearances of two cameras are shown in figs 1 and 2.

Table 1: Specification of high sensitivity camera

Image sensor	1/2.9 inch SONY Exmor IMX322 CMOS Image sensor
The number of pixels	2.2Megapixcel, 30fps
Output resolution	Full HD 1920×1080
Lens	F=2.8mm-12mm
The minimum illumination	0.05 lx
Digital zoom	×1.0-8.0

Fig. 1 Far-infrared camera

Fig. 2 High sensitivity camera

3. EXPERIMENT

The experiments were executed inside and outside of buildings of university. The indoor experiments are simulations of lecture and the outdoor experiments are those of attending school. The devices used in the experiments web camera, the far-infrared camera, the high sensitivity camera and a night-blindness simulation glasses for normal person. The experiments are carried out with cameras described above under the condition that night blindness loses one's sight. From now on we call normal students wearing the simulation glasses as night blindness students. For the experiments the brightness is measured with HBCN3005 made by Hobbes Corporation.

3.1 The indoor Experiment

The first indoor experiment is a recognition test of characters on a white board and stationaries on a desk under a small light source. As the far infrared camera could not capture any character images at all under our co ndition, we omit the results and present the results by the high sensitivity camera. The arrangement plan of classroom is shown in Fig.3. In the room, a light source locates near the white board and the measurement are carried out at the white board and three desks located with different distances from the white board, 0.5 m, 4.7 m and 7.1 m. These three positions correspond to the front, the middle and the rear of classroom.

The brightness under the light source is 50 lx and that at the desk are 16.3 lx, 5.63 lx and 2.69 lx as shown in the Table 2. In the table, we also give scenes captured by ordinary cameras, ones that the night blindness student directly sees and ones that the night blindness student sees with the high sensitive camera.

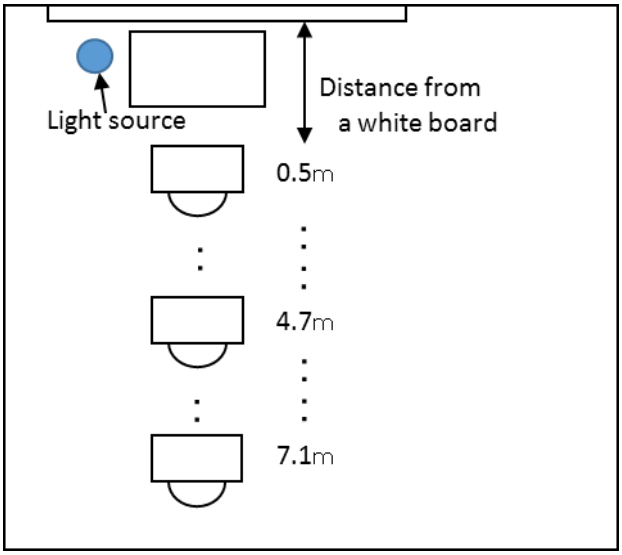

Fig. 3 Arrangement plan of classroom

The normal students can see characters on the white board in spite of the location of desk and the night blindness student cannot. On the other hand, the night blindness student can see the characters by using the high sensitive camera.

The second indoor experiment is a recognition test of stationery on desk. Photo of characters, stationery and books on desk are given in the Table 3. In spite of turning on lights the night blindness student cannot directly see stationery on the desk. The result is the same for the latter. On the other hand, for the both cases with the high sensitive camera the night blindness student can see them.

3.2 Outdoor experiment

After the sunset, we carried out the outdoor experiments at a school gate, at parking, and at an intramural road shown in the Table 4. During the experiments, the brightness was changed from 1.67 lx to 0.34 lx. At the former of the illumination, the night blindness student hardly saw anything, and at the latter of the illumination, the ordinary student could, as seen in the table.

In the Table 4, we give scenes seen by a night blindness student directly and through the far-infrared camera and the high sensitive camera. As the far-infrareds camera detects heat sources and reflections of heat, we could recognize a person and a car. On the other hand, the high sensitive camera could gave the night blindness student clearer scenes than ones the normal student saw.

3.3 Experiment evaluation

By the indoor experiments, as the high sensitive camera was better than the normal person's eye, the night blindness student could recognized objects with it. In outdoor, dangerous accidents in outdoor are collisions with persons, bicycles, or cars coming at. These could be detected by both of the cameras.

4. CONCLUSION

We performed simulations that the night blindness students attended a lecture in dark classroom with video projector and that they commuted to school after the sunset. We tried two types of cameras, the far-infrared camera and the high sensitive one. By the indoor experiments, we found that the high sensitive camera was effective to capture scenes in classroom. By the outdoor experiments, the both were effective.

The night blindness students can spend their time without incidents except dark places. We would like to expect that they could spend their college life safely and fruitfully by our support system.

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Table 2 White board

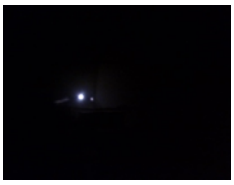
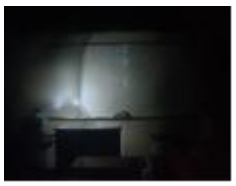
A place and illumination	a scenery photograph	the scenery photograph which the night blindness looked at	the scenery photograph taken with the high sensitivity camera which the night blindness looked at
The desk of front sequence 16.3 lx			
The desk of a central sequence 5.63 lx			
The desk of a back sequence 2.69 lx			

Table 3 Photography on desk in classroom

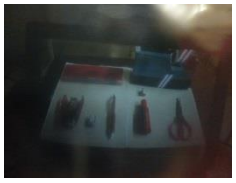
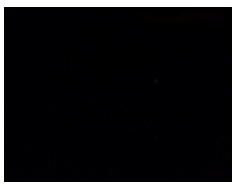
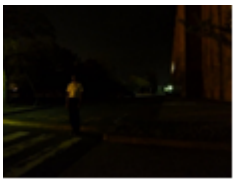
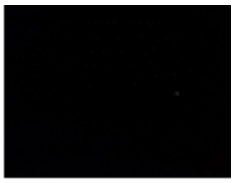
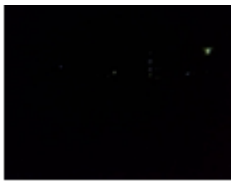
A place and illumination	a scenery photograph	the scenery photograph which the night blindness looked at	the scenery photograph taken with the high sensitivity camera which the night blindness looked at
Printed matter on a desk 54.6 lx			
Stationery (1) 54.6 lx			
The state which erased the fluorescent light (Thin light) Stationery (2) 19.56 lx			
The state which erased the fluorescent light (Thin light) Textbook 0.86 lx			

Table 4 Outdoor Photo scene

A place and illumination	a scenery photograph	the scenery photograph which the night blindness looked at	the scenery photograph taken with the far-infrared camera which the night blindness looked at	the scenery photograph taken with the high sensitivity camera which the night blindness looked at
The scene from a school gate 1.67 lx				
The scene of the car which the light has turned on 0.34 lx				
The scene of the car by which the light is off 0.34 lx				
The scene which stands for people 0.43 lx				
The scene along which people are walking 0.34 lx				
The scene of a bicycle 0.5 lx