CdS Photo-Sensor Simulate the Signal Transmission for Display Evaluation

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ABSTRACT

To understand the imaging metric evaluation, a retina model is being constructed by the microchips with the CdS sensor to model the transmission of the pixel signal. Such configuration can be applied to the interactive display environment between the surrounding lightings and the contrast of the display. Information on the response time and the criterions to maintain the image qualities can be model.

1. INTRODUCTION

Simulate the operating principle of retina sensing are one of the promising engineering concepts in various area, which meet part of the demands of the Neuron-disease [1]. Human eye optics and retina are a very important biological sensation system. On that point are still tremendous questions required to be clarified for clinical investigation, medical, scientific discipline and industrial purpose [2]. Therefore, it is necessary to construct such model to understand the influences for signal interaction within the retina structure. Structure of retinal cell can be found in [3, 4], while the number of cells in a specific location on the retina can be described in [5, 6]. Consider the computational efficiency to model the optical effects and the signal response, equivalent hardware is required. One can consider the distribution of the three major colors sensing cone cells (L-cone, M-cone and B cone) that corresponding to the three central peak wavelengths. Based on the demands mentioned above, in this report, CdS based photo-sensor is introduced to simulate signal transmission for display evaluation.

2. MATERIAL AND METHODS

2.1 Human eye and visual receptor

Light is refracted through the cornea, passes through the pupil and the lens, to reach the retina. Finally, it is transmitted to the brain via the optic nerve. There are two types of visual receptors in the retina: Cones (cell number around 5 to 7 million, photosensitive ability is weak, major in colors) and Rods (cell number around nearly 100 million, very sensitive to light, major in brightness).

There are few literatures investigating the details and unified modelling that combined both the human eye and the refined retina model. To deal with the subjects that concerns with the higher vision qualities, the patterning on the response of the retina is critical.

2.1 CdS simulated human eyes cell schematic

We contend that an integrated detailed retina model of the human eye should be able to model the propagations of the photoreceptor signals. This model can build and contribute as a tool to simulate and mimic visual sensitively than the other traditional optical model. The idea is that the display device can have more than 50 CdS sensors, and all these sensors can be cascaded together to become an adaptive-interactive interface between the user and the information display device. In the present study, three different layers of CdS are introduced to compare the values of the signal transmission.

Figure 1 shows the scenario for the three layers CdS sensor structure to mimic the retina cell signal transmission. The left part is the single CdS sensor, while the right part demonstrates the three different numbers of CdS sensors. *Recall that each CdS represent a cluster of retina cells*. The purpose is to exam the signal transmission are used in parallel to compare the signal deformation of the three layers. Figure 2 Comparison of spectrum of CdS to various photo-electronics devices. One can see that the CdS sensor is a good modeling device to the human eye.

Figure 3 provides the comparison between the human retina structures to the present simplified hardware. Notice that we simplified the complicated layer structures into only three layers and each layer is represented by an Arduino Nano chip. During the experiment, the light source will illuminate on the CdS sensor, which leads to the variations of the signal that simulate the retina's response, then the signal will transmit thought layers to the central nerve system for the visual perception. The advantage of this simplified hardware model is that it can be modified through electronics component to modulate different scenario of the visual application, and the characteristic of the neuro can also be realized by the LRC circuits without difficulties. Features can reproduce several important retina properties, such as perception, response delay, color separation, effects on the damages of the cell layers and transmit signal distortion between layers for different color spectrum or brightness.

3. RESULTS

Figure 4 is the in-house experiment apparatus with Solar simulator to represent the natural light spectrum for the possible information display application, while figures 5-8 give the comparison results for different layers and spectrum. Notice the variations for the signal transmission in the present manifestation. Figure 5 represents an initial impulse with RGB= (150,350,110) become RGB= (300, 350, 110) in the first layer of the retina, then become RGB= (300,370,150) during the transmission in the second layer, and finally reach the last layer with the response as RGB= (105,300,100). This demonstration exhibit that each layer can modulate the signal and shift the image data. Abduction on the biological and chemical effects effect can be implemented through this simplified hardware.

Another importance visual perception properties are the response time, which cause such as the flickers, the visual persistence, etc. Figure 9 show that the signal transmission from the first layer to the third layers can remain the synchronization for most time. The interesting thing is that the Pearson correlation coefficients between layers is not guaranteed to be high. This leaves a possible mechanism for this model to simulate the visual defect (e.g. cause by neural disease) for the individual for temporal type scanning display device.

4. CONCLUSION

This report presents a simple hardware to construct and integrated the detailed retina model at human eye with specific distribution of the photoreceptor cells, which can build and contribute a practical scheme to simulate and predict real visual sensitively than the perfect computer model. Effects on the cell clusters can be examined through this CdS sensor hardware, and the imaging technicians, display system designers, experts for optometry and the bionics scientist can all benefits from this device.

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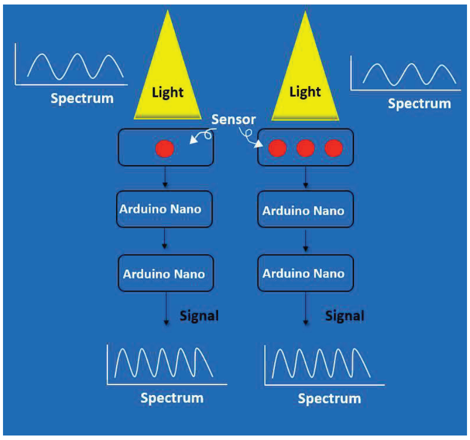

Fig. 1 CdS simulate the retina pixel

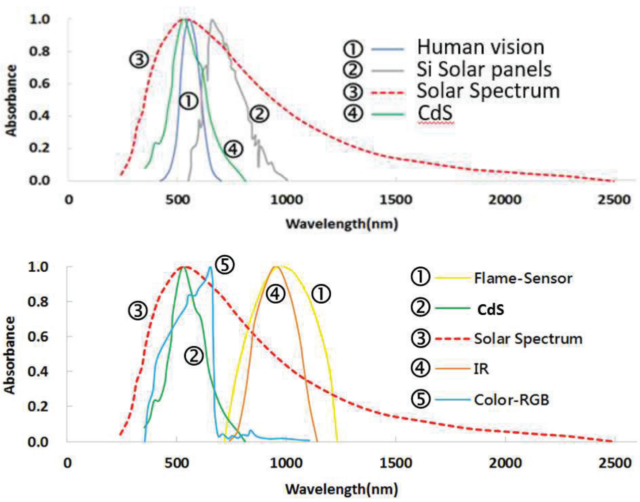

Fig. 2 Comparison of spectrum of CdS to various photo-electronics devices

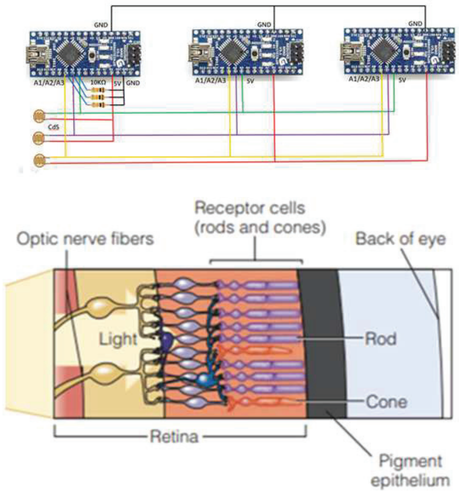

Fig. 3 Retinal layers [4] and hardware for simulating the signal transmission. Note that there are three layers.

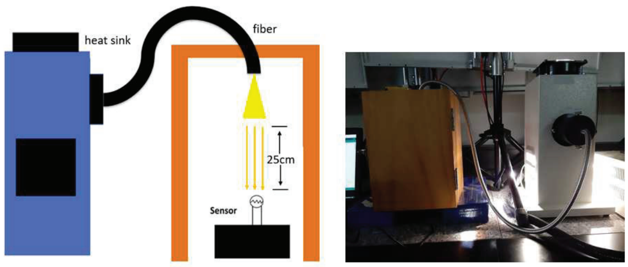

Fig. 4. experiment apparatus

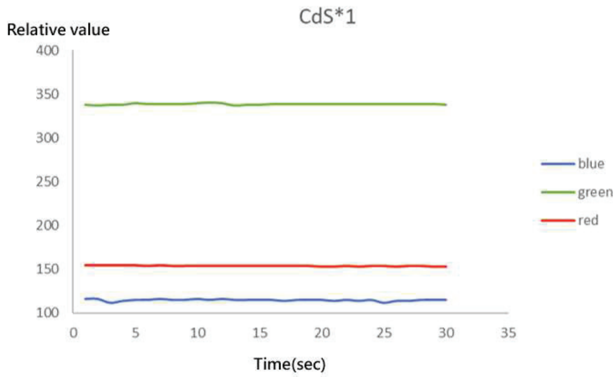

Fig. 5 exciting response for the CdS sensor with three color

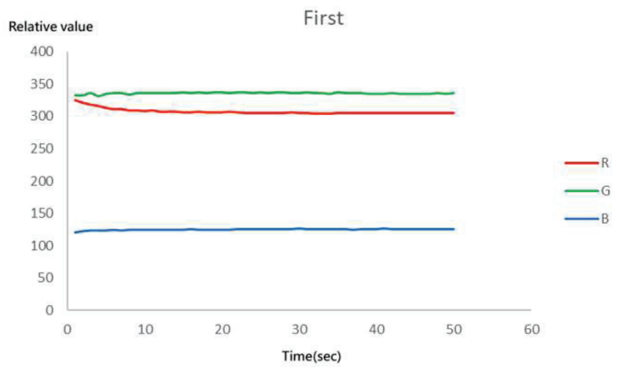

Fig. 6 response measured from the first layer

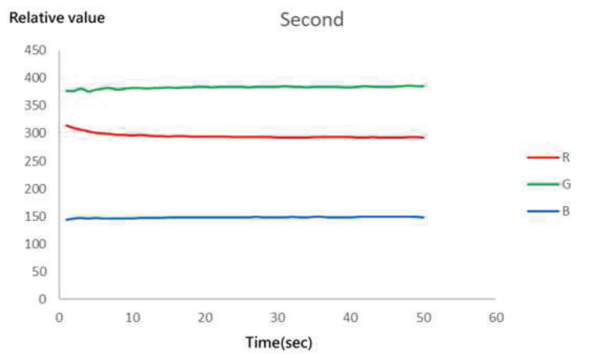

Fig. 7 response measured from the second layer

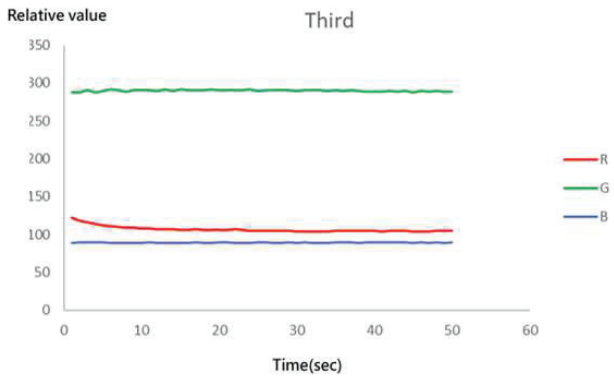

Fig. 8 response measured from the second layer

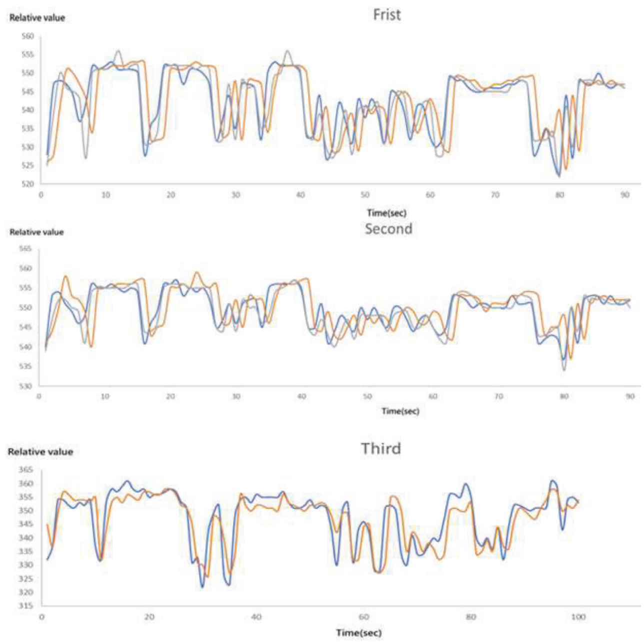

Fig. 9 exam the synchronization and the deplay between impluse signal and different layers