Chapter 9
Real-Time Recoloring Ishihara Plates Using Artificial Neural Networks for Helping Colorblind People

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ABSTRACT

Vision sense is achieved using cells called rods (luminosity) and cones (color). Color perception is required when interacting with educational materials, industrial environments, traffic signals, among others, but colorblind people have difficulties perceiving colors. There are different tests for colorblindness like Ishihara plates test, which have numbers with colors that are confused with colorblindness. Advances in computer sciences produced digital assistants for colorblindness, but there are possibilities to improve them using artificial intelligence because its techniques have exhibited great results when classifying parameters. This chapter proposes the use of artificial neural networks, an artificial intelligence technique, for learning the colors that colorblind people cannot distinguish well by using as input data the Ishihara plates and recoloring the image by increasing its brightness. Results are tested with a real colorblind people who successfully pass the Ishihara test.

DOI: 10.4018/978-1-5225-8539-8.ch009

INTRODUCTION

The sense of sight allows biological organisms to acquire images of their environment, allowing them to identify food and dangers. Humans require its vision sense to read, write, identify signposts, drive, among other activities (Porrero & Juan M., 2005).

Vision is possible thanks to the eyes, which use two types of cells for the perception of images, the rods and the cones. (Richmond Products, 2016). The rods are sensitive to the amount of light or brightness perceived, i.e. the magnitude of the light wave. (Ruki Harwahyu, 2011). Light wave frequency or color is perceived through the cones, these cells are generally found in three variants that identify basic colors, i.e. the amount of red, green and blue perceived (Colblindor, 2016).

Color is a sense, which is in the brain and is obtained from the signals of the neurons connected to the cone outputs that are activated when light strikes the frequency corresponding to each photo receptor (Tanaka, 2015).

Usually people have only cones that perceive the red, green and blue colors and the other colors are obtained as the result of combinations that are generated by the interaction of light magnitudes in tune with the frequencies of these basic colors. (Deeb, 2004).

There are peculiar cases in which human beings have a fourth cone, as well as some species of birds, that is, they are tetrachromats, allowing them to perceive a greater range of colors, compared to the colors perceived by people who have three cones or trichromats (Tanaka, 2015; Robson, 2016).

Tetrachromats, despite having extrasensory abilities compared to most people, often have difficulty interacting with the world and expressing their opinions about some colors, as the environment is designed for trichromats which are dominant compared to other groups (Robson, 2016).

Colorblindness

There are also people who can perceive fewer colors than the average, this condition is called colorblindness, described in a scientific work for the first time in 1793 by John Dalton who also suffered from colorblindness, in his work it is mentioned that the perception of color is due to a colored liquid in the eyes, however, it is proven that this statement was not correct at the time of his death, when scientist analyze his eyes (Colblindor, 2016).

People with color blindness often have problems with their environment and the world in which they live, since as tetrachromats, have difficulties interacting with trichromats in activities that involve a correct perception of color. Some examples

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Lisa A. Proctorand Ye Wang (2015). *Recent Advances in Assistive Technologies to Support Children with Developmental Disorders (pp. 45-78).*
www.irma-international.org/chapter/using-ipads-and-mobile-technology-for-children-with-developmental-disabilities/131329