ColorADD: Color Identification System for Color-Blind People

27

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27.1 Introduction to the Colorblindness Problem

Colorblindness is the common denomination to a congenital alteration related to the incapability to distinguish several colors of the spectrum due to a visual deficiency (Fig. 27.1).

These people have a normal vision relatively to the other characteristics which compose it, even though the deficiency hampers or even makes it impossible for those afflicted to perform certain everyday social and professional tasks. Colorblindness affects approximately 350 million people – 10% of the world's population – and it's a handicap usually of genetic origin associated to a flaw in the X chromosome. Because of this, 98% of color-blind people are male.

The first symptoms of colorblindness are detected at school age due to the difficulty in interpreting drawings and maps and identifying colored pencils. Later in life a color-blind person is prohibited of performing certain jobs, while some professions will bring added difficulties. Similarly, managing daily routine poses problems, as well as, for instance, buying and choosing wardrobe as well as using maps and signs to provide orientation. Even while accessing the Internet, some texts can become illegible due to the use of certain colors.

Some companies have started creating web pages which can be seen correctly and easily by all. This has been possible due to the rising awareness that color-blind people represent a high percentage of the world population [1–3].

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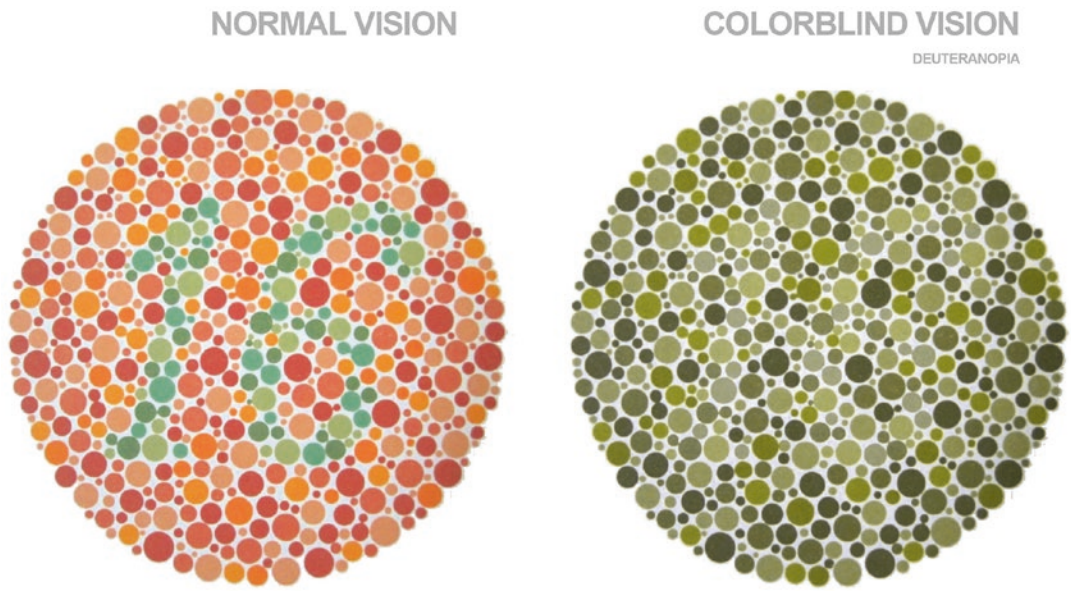

Fig. 27.1 Color-blind vision

27.2 Objectives and Methodologies

Once the problem had been identified, its extent and impact on the subjects was evaluated. On a first phase of the study, a sample of color-blind people was identified and presented with a questionnaire. Its purpose was to identify the main difficulties of the respondents concerning their colorblindness and the processes and methods used by them to lessen and overcome these obstacles.

The collected information was treated and analyzed. Based on these results, a conceptual basis was defined, capable of constituting a universal method of graphic color identification, easy to comprehend and memorize [4].

27.3 Materials and Methods

Using primary colors, represented through simple symbols, the system was constructed through a process of logical association and direct comprehension, allowing its rapid inclusion in the "visual vocabulary" of the user. This concept makes additive color a mental game, which lets the colorblind relate the symbols among each other and with the colors they represent, without having to memorize them individually.

The system proposed is based on the search of the pigment color, using as basis the primary colors – blue (cyan), red (magenta), and yellow its additive secondary colors (Fig. 27.2) and not the light color (RGB) – because the color-blind person does not possess the correct vision of the colors nor a tangible knowledge of how their addition works.

Each primary color of the code is associated to a graphic form (Fig. 27.3) which represent red, yellow, and blue; from these three forms the code is developed.

Two additional forms were added representing black and white (Fig. 27.3); in conjunction with the other elements, they represent lighter or darker tons of the colors.

The secondary colors can be formed using the basic forms as if "mixing" the primary pigments themselves (Fig. 27.4), making their perception and subsequently the composition of a color pallet easy [5, 6].

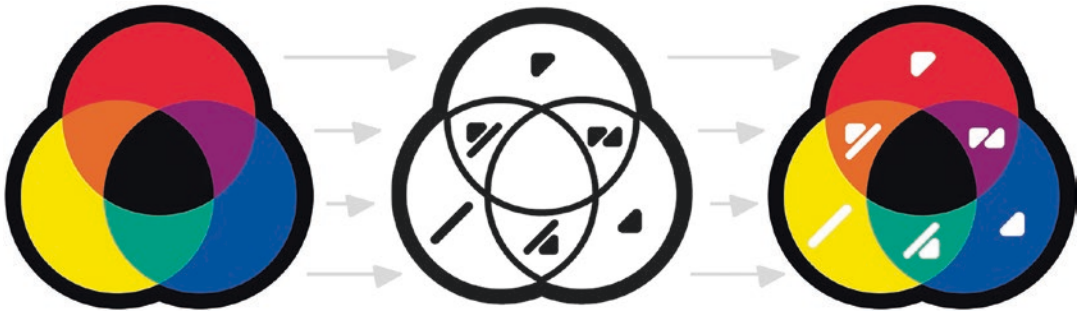

Fig. 27.2 Primary color addition – pigment colors

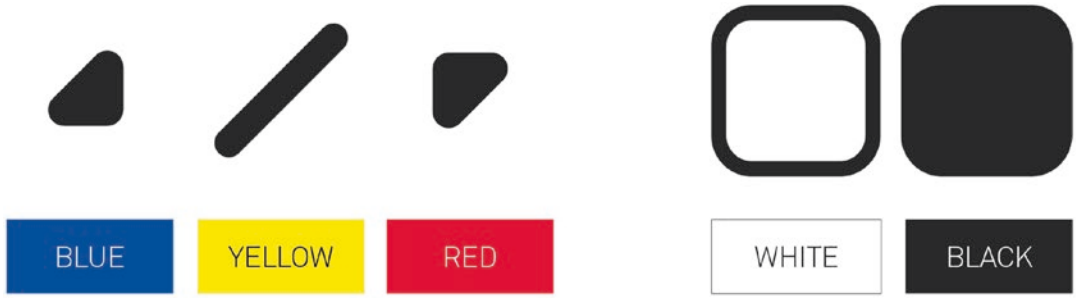

Fig. 27.3 Graphic symbols for three primary pigment colors and *white* and *black*

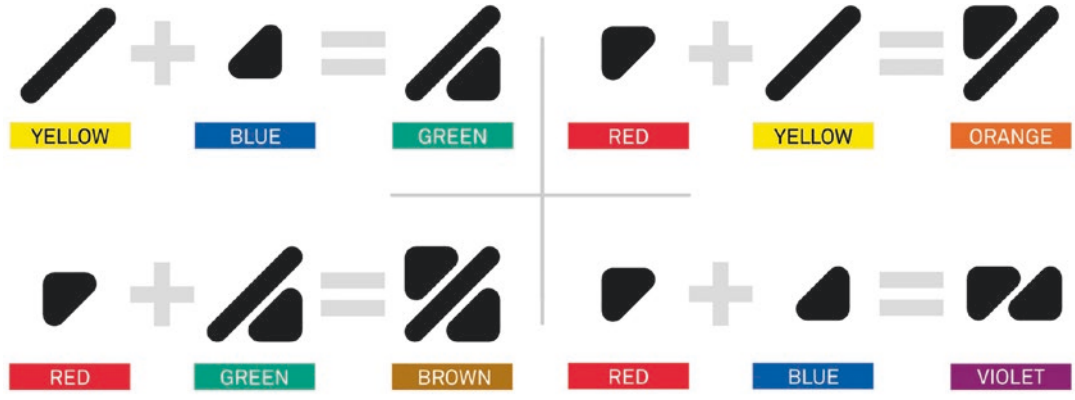

Fig. 27.4 Graphic symbols – three primary colors and their addition

Fig. 27.5 Graphic representation of color addition with dark and light

Fig. 27.6 Graphic symbols – tons of gray

Fig. 27.7 Graphic symbols – gold and silver

By associating the icons representing white and black to define darker and lighter tones to the three basic forms and their additions, a wide palette is constructed as observed in Fig. 27.5.

Conventional color designations were attributed to the additions and other combinations of colors, especially those used in apparel.

Grey was divided into two tones: light grey and dark grey (Fig. 27.6). The importance of gold and silver in clothes implies the creation of a specific icon. Considering the logic of the codes' construction, these colors are represented by the combination of the dark yellow and the element representing shine to define gold; light grey with the same element identifies silver (Fig. 27.7).

The totality of the code, represented in Fig. 27.8, covers a considerable number of colors and can be easily conveyed through information posted at the sales point, on web sites, or the product itself (Fig. A) [7–9].

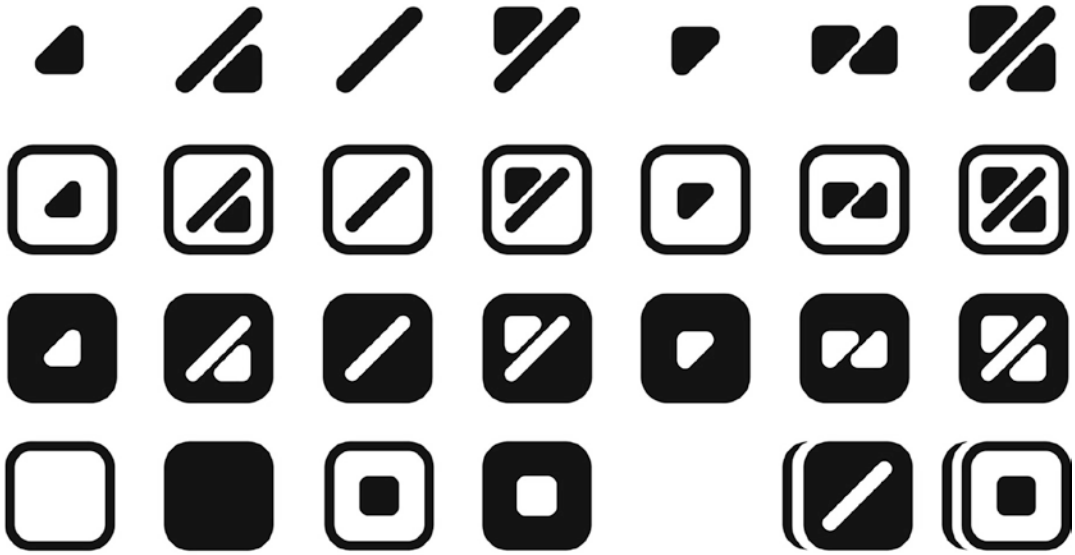

Fig. 27.8 Monochromatic graphic code

27.4 Results

The application of the system is transversal to all the areas of the global society, regardless of their geographical localization, culture, language, and religion, as well as to all the socioeconomic aspects.

27.4.1 School and Stationery

It is at school age that usually appear the first and sometimes traumatic situations and difficulties caused by the wrong color identification.

The inclusion of the system in the school and stationery leads to inclusion (Figs. 27.9 and 27.10), allowing the color-blind kid a perfect integration, with no doubts and shames.

27.4.2 Sports and Sportive Activities

In all sportive activities, especially those played in group, color has a decisive role – it helps in differentiating teams, players, contestants, etc. In fact, color in sports is so relevant that, during the Football World Championship in South Africa, the ball initially proposed was orange – this fact prevented color-blind people from distinguishing the ball from the grass, and, after some official requests, the ball was changed into a white one, thus allowing everyone to see the match in equal conditions (Fig. 27.11).

Fig. A A more colorful "Rubik Cube"

Also in sport competitions and events, color is an important element, not only to identify the physical space of the event but also to permit identifying the different teams/countries

Fig. 27.9 School material (real implementation)

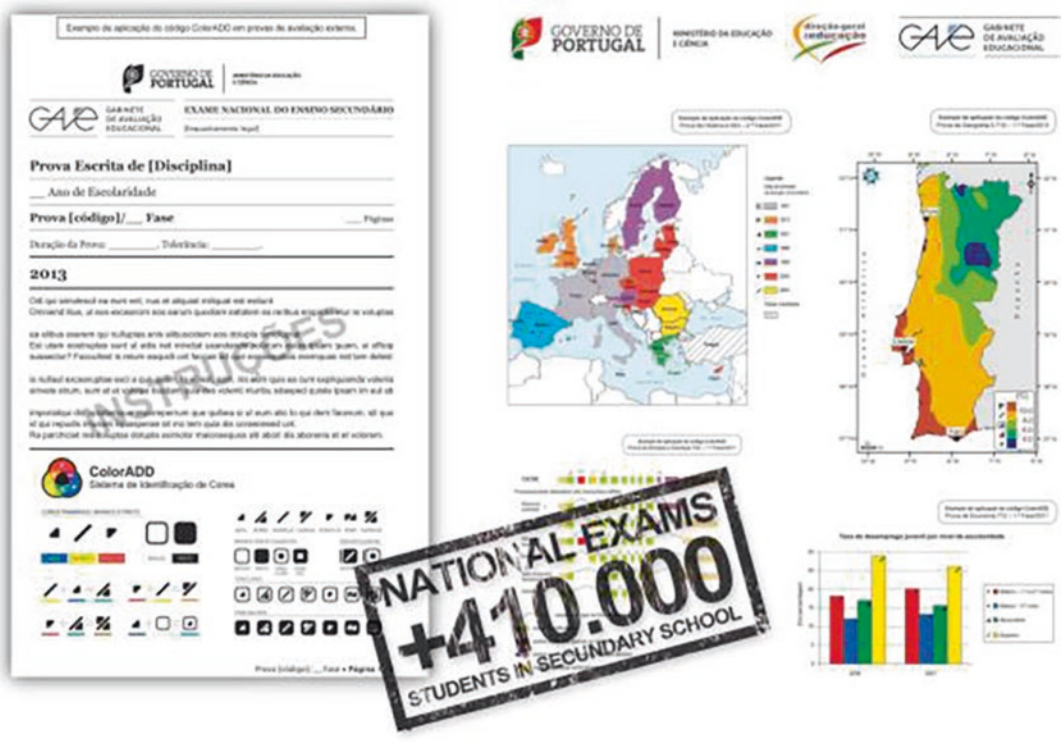

Fig. 27.10 National exams (real implementation)

Fig. 27.11 Colorblindness simulation – deuteranopia – for a sportive action and logistics

participating – ColorADD has already been applied during the CPLP Games, at Mafra, Portugal (in 2012), either in team/country identification, through the badges, or in the event organization itself.

27.4.3 Health and Services

The selection of patients at hospitals is made through color. At the ER, an evaluation of the grade of "gravity" of a patient is carried out, and a bracelet corresponding to a certain grade of priority is provided.

The inclusion of the system in hospital services and spaces where color is an element of identification and guidance makes orientation an easier task to colorblind.

In many places, color is the element of identification of the different services (Fig. 27.12).

A colorblind, resulting from its handicap, cannot identify the color and its meaning. Also, many medicines have color as an identifying factor (Fig. 27.13).

27.4.4 Transports

The Metro system maps are a different context but equally valid on what concerns the use of the color identification code, in this case to individualize the different transit lines (Fig. 27.14).

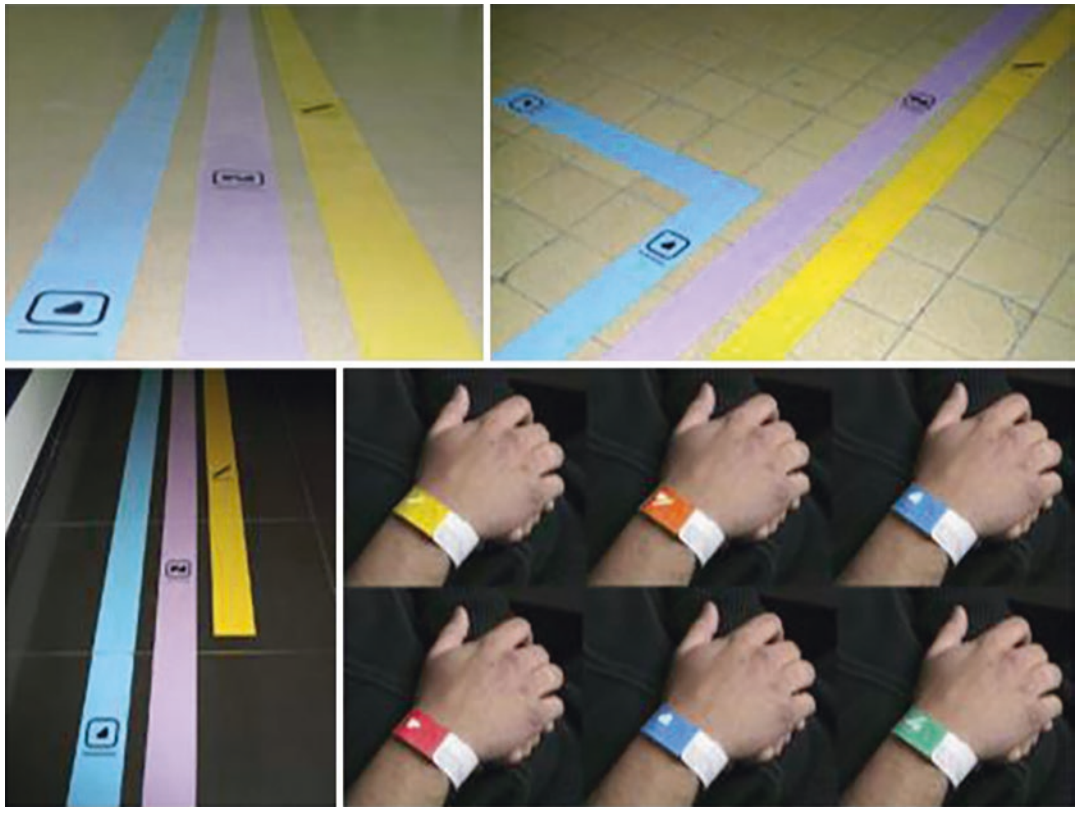

Fig. 27.12 Heath and hospitals (real implementation)

Fig. 27.13 Heath and hospitals (real implementation)

Fig. 27.14 Porto Metro map (real implementation)

27.4.5 Clothing and Textiles

The developed code can be applied in multiple contexts in which color is important. One of the most relevant fields of application is in apparel, and the color identification symbols can be applied to tags or integrated into the clothes themselves, similarly to maintenance and care information. The simple and stylized graphics and its monochromatic nature reduce the production cost of the labels in paper or cardboard, textile, or stamp (Fig. 27.15) and other implementation in cross sector (Fig. 27.16).

Fig. 27.15 Application clothing tags (real implementation)

27.4.6 ColorADD in Other Sectors

Fig. 27.16 Examples of different areas where the code is already in use: Recycling bins, City maps and Nutricional traffic light

Conclusion

Each day society grows more individually centered. Each person, sometimes, becomes totally dependent on itself, and asking for another person's help, besides creating some frustration and feelings of dependence, is not always even possible.

The "wrong" interpretation of colors can harbor insecurity in social integration of the individual whenever the projected personal "image" is a key factor in rendering judgment.

The color identification system, aimed at colorblind, can be greatly beneficial to a group which represents such a significant percentage of the population. Its use, given the characteristics of the system, means a practically insignificant cost, and its adoption by the industry and society can improve the satisfaction and well-being of a group of individuals whose particular vision characteristics deprive them of a fully independent and quiet everyday experience of choosing the right color.

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