

SAFETY INFRARED DESIGN OF A PORTRAIT PICTURES ON A FASHION CLOTHING

SIGURNOSNI INFRACRVENI DIZAJN SLIKA PORTRETA NA MODNOJ ODJEĆI

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Abstract

The dual VZ camera observes two spectra, one in the visual V system (400 to 750nm), and the other in the near infrared Z system (750 to 1000 nm). A clothing design with dual content, for visual and infrared area was created. The design is based on a computer graphic design, which was used to create an abstract portrait design for the V system, while the Z system uses design that incorporates individualized graphics - simplified profile view. Computer graphics are done on canvas. The computer analyzes each stage through both systems (from 400 to 1000nm). The cameras capturing images are adjusted to simultaneously record day and night views. The artwork in this paper is invisible IRD graphic and both displays in this experimental work are linked in the way that they present a portrait and profile photography of the same person making the profile photography the individualized hidden information.

Keywords: *safety clothing, close infrared spectroscopy, abstract design, dual camera, infrared fashion design*

Sažetak

Dvojnomo VZ kamerom promatraju se dva spektra, od kojih je jedan u vizualnom V sustavu (od 400 do 750nm), a drugi u blisko infracrvenom Z sustavu (od 750 do 1000 nm). Kreiran je dizajn odjeće sa dvostrukim sadržajem za vizualno i infracrveno područje. Dizajn je zasnovan na računarskoj grafici kojom je za V sustav kreiran apstraktni dizajn portreta, dok je za Z sustav u dizajn ugrađena individualizirana grafika

- pojednostavljeni prikaz fotografije profila. Računarska grafika je izvedena na platnu. Računalom se analizira svaki stadij kroz oba sustava (od 400 do 1000nm). Kamere kojima su snimani prikazi doradene su tako da istovremeno snimaju dnevni i noćni prikaz. Umjetnički rad je nevidljiva IRD grafika, a oba prikaza u eksperimentalnom radu povezana su tako da se radi o portretu i fotografiji profila iste osobe gdje je fotografija profila individualizirana sakrivena informacija.

Ključne riječi: *sigurnosna odjeća, bliska infracrvena spektroskopija, apstraktni dizajn, dualna kamera, infracrveni modni dizajn*

1. Introduction

1. Uvod

A large number of security cameras located in the areas that surround our everyday lives, record images during the night as well as during the day are resulting in new ideas for the use of security computer graphics. In addition to security purposes and disabling reproduction, a new idea of application in the artistic aspect by combining the two design graphics (one concealed and the other visible) has emerged.

In order to create dual graphics, twin dyes were created [1]. The twin dyes are two color recipes that give the same tone in the visual system (V system). In the near infrared system (Z system), one color does not absorb close infrared light and is visible only in V system unlike the other color [2].

Design graphics made with these two colors are viewed using a dual VZ camera that captures both spectra (V system and Z system) [3]. The V system captures images from 400 to 750 nm, while within the Z system (close infrared system) images are visible from 750 to 1000 nm.

Using the computer analysis, twin dyes can be described numerically and through the spectrum, thus determining their difference in the Z system [4]. Until now, twin dyes were used solely for the creation of securities and documents [5], however through the described experiment the application has been extended to the design of dual graphics for fashion clothing. The design was done using the design principle of safety camouflage clothing [6] [7]. Dual graphics were created using the existing twin dyes used for the printing industry [8]. Graphics were printed on the canvas used for the designer clothing that already contained a dual design image [9]. Such a safety infrared design is already applied on clothing whose main purpose isn't security clothing, rather transferring a message through the dual design e.g. for the purpose of tourism or some other promotion [10].

2. Colors for creating dual spectrum graphics

2. Boje za izradu grafika dualnog spektra

The colors used for the creation of VZ graphics were created for the digital printing on canvas applicable to the clothing production. The paint was made using the ink for the industrial plotter / printer. Twin dyes were created in the manner that twin pairs were analyzed in the visual spectrum in order to be as similar as possible. For achieving similarity, the value ΔE must be less than three. The color duality estimation is performed with spectrography in the range of 400 to 900 nm. Graph 1 shows twin spectra of three different colors designated as s (brown), z (green) and c (red). CMYK color twin recipes are shown in Figure 1.

All the colors in the Z system have a default light absorption value of 0.15 to 900 nm in order to provide controlled light absorption. Spectrographs were created using the selective scan used for the forensic procedure [4]. In Figure 1, Z twins are marked with dashed lines. In the wavelength of 900 nm the values of all twin V colors are equal to zero.

The Z camera does not register V dyes due to their wavelength. All color pairs in this experiment have the same distance from ΔZ to the Z point. The twin dyes have equal values of light absorption in the visual scope between 400 and 700 nm.

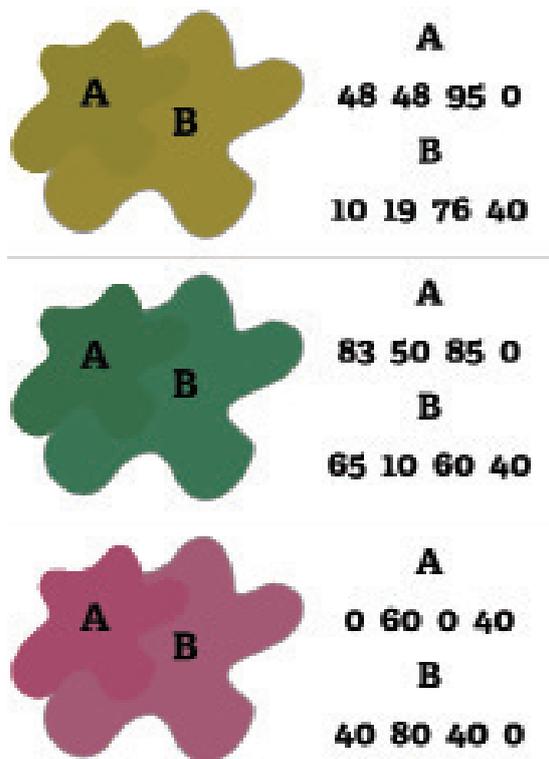
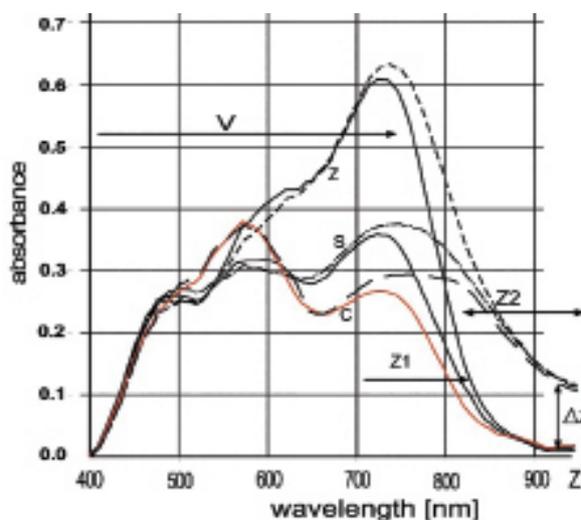


Figure 1 CMYK twin color recipes

Slika 1 CMYK recepture blizanaca bojila



Graph 1 Color spectrographs

Grafikon 1 Spektrogrami boja



Figure 2 Mannequins-volunteers and fashion show authors that have designer clothes on themselves;

Photo: Nina Đurđević

Slika 2 Manekenke-volonterke i autorice revije koje na sebi imaju dizajnersku odjeću;

Foto: Nina Đurđević

3. Security infrared design on fashion clothing

3. Sigurnosni infracrveni dizajn na modnoj odjeći

Combining safety infrared design and fashion clothing design is still a novelty. In 2018, as a part of the International Street Festival in Zagreb, a fashion show designed by two authors Jana Žiljak Gršić and Dijana Nazor was presented under the title "Fashion Show with hidden IR messages - Look at me!" A large screen that displayed images through the infrared security camera was installed and visitors could see messages on the screen that were hidden in particular garments. Some of the messages were: "Love me," "Dance with me!" "Look at me!", "Smile!" etc. Figure 2 presents models and a large screen showing the infrared spectrum image.

This show is certainly a shift in the fashion industry, and this is just the beginning of discovering new fashion design options. The infrared spectrum design is a unique innovation in the world, and the range of applications is very wide. For the purpose of this show, design of two fashion visuals was made experimentally, each consisting of two images, one of which is visible in the visual spectrum and the other in the infrared spectrum. The emphasis is on the infrared design innovation applicable to every creative form conceived by designer.

4. Image portrait design for visual spectrum

4. Dizajn slika portreta za vizualni spektar

The portrait image design for the visual spectrum was created using the "low poly art" technique. "Low poly art" is a computer graphic technique that is mostly used to display 3D graphics. This is a representation of the polygonal network where the image is converted into a set of triangles by which a visual impression of the volume, i.e. 3D display, is transmitted. "Low poly" can be created using mathematical calculations, but it can also be produced manually. In our case, the graphics were made using the photos of the face and a retrospective method used to select each part of the photography triangularly. Thereafter, the selected part floats in the mean value of its coloration.

A polygonal web was created, and the main structural characteristics of the motif were retained. Different colorings on individual parts are bordered to emphasize the shape of the face, hair, lips etc. Thus the character remains recognizable. Design itself remains a rounded theme presenting a particular person through a visual spectrum of "low poly art" design, and through a security graphic using a simplified face profile photo. Figure 2 shows the "low poly art" portraits that are visible in the V spectrum, and in Figure 3 shows the simplified photo of the face profile visible in the Z spectrum.



Figure 3 "Low Poly Art" portraits

Slika 3 „Low poly art“ portreti



Figure 4 Simplified photos of the face profile

Slika 4 Pojednostavljene fotografije profila lica

5. Conclusion

5. Zaključak

Usage of dual cameras creates a large variety of options for the infrared design. The technique is used in the fashion design, where a design is displayed simultaneously in visual and close infrared spectrum. The application is wide, because this process can hide various messages and creative design representations. For the purpose of textile dyeing, twin dyes are used for adding invisible information to the fashion clothing. The dyes are mixed in duality. Each color tone (equal to the visible spectrum) is differently absorbed in the near infrared spectrum, which incorporates protected information visible only with the NIR camera. Although usage of this technique is new in the fashion industry, this paper presents the development of a new method for fashion clothing design and a possible application in general in the fashion industry. A "low poly art" design with built-in hidden image was designed, and twin colored V and Z dyes were developed for printing. Apart from the ability to create a variety of design solutions, INFRAREDESIGN® also disables the reproduction, i.e. creates protection of fashion and design itself. Infrared design creates a major shift in the fashion industry and the possibilities of its use, while its further application is still explored.

6. REFERENCES

6. REFERENCE

- [1] Ivan Pogarčić, Ana Agić, Maja Matas; EVALUATION OF THE COLORANT TWINS FOR THE NEUTRAL GREY SPECTRA IN INFRARED GRAPHIC PROCEDURE // Tehnički vjesnik 23, 6(2016), p:1659-1664; ISSN 1330-3651, ISSN 1848-6339; DOI: 10.17559/TV-20150303132036; Hrcak ID: 169526
- [2] Vilko Žiljak, Klaudio Pap, Ivana Žiljak-Stanimirovic, Jana Žiljak-Vujic. MANAGING DUAL COLOR PROPERTIES WITH THE Z-PARAMETER IN THE VISUAL AND NIR SPECTRUM // Infrared physics & technology. Vol.55 Issue 4, pp. 326-336;2012 Elsevier B.V, DOI: 10.1016/j.infrared.2012.02.009

- [3] Ivan Rajković, Vilko Žiljak; USAGE OF ZRGB VIDEO CAMERA AS A DETECTION AND PROTECTION SYSTEM AND DEVELOPMENT OF INVISIBLE INFRARED DESIGN // Polytechnic & Design; ZAGREB UNIVERSITY OF APPLIED SCIENCES; Vol. 4, No. 1, 2016. pp: 54 - 59; ISSN 2459-6302; ISSN ;1849-1995; DOI: 10.19279/TVZ.PD.2016-4-1-07
- [4] Projectina Docucenter 4500, Switzerland, <http://forensictechnology.com/projectina/>
- [5] Ivana Žiljak-Stanimirović, Jana Žiljak-Vujić, Maja Matas. INFRARED COLORANTS AS TWINS FOR SECURITY PRINTING OF DOCUMENTS AND SECURITIES // 45th Conference of the International Circle of Educational Institutes for Graphic Arts Technology and Management (IC), Toronto, Canada 2013. pp. 28-35. ISSN 1868-0712
- [6] Ana Agić, Ivana Žiljak-Stanimirović, Darko Agić, Petar Miljković. REDUCTION RATE STRATEGIES BY PROGRAMMED NIR DUAL IMAGE REPRODUCTION PROCESS; STRATEGIJA IZNOSA ZAMJENE KOD PROGRAMIRANE DVOJNE SLIKE U NIR REPRODUKCIJSKOM PROCESU // POLYTECHNIC & DESIGN, Zagreb; Vol. 3, No. 3, 2015 p: 250 - 257-, ISSN 1849 - 1995; DOI: 10.19279/TVZ.PD.2015-3-3-13
- [7] Jana Žiljak-Gršić, Lidija Tepeš-Golubic, Ula Leiner, Denis Jurečić. HIDDEN INFORMATION IN INFRARED SPECTRUM ON SAFETY CLOTHES // 28TH DAAAM International symposium on intelligent manufacturing and automation; 2017, Zadar; DOI: 10.2507/28th.daaam.proceedings.032
- [8] Jana Žiljak-Gršić; NEAR INFRARED SPEKTROSKOPY IN PRINT TECHNOLOGY // POLYTECHNIC & DESIGN Vol. 5, No. 1, 2017. pp: 32-36; DOI: 10.19279/TVZ.PD.2017-5-1-05
- [9] Jana Žiljak, Lidija Tepeš Golubic, Denis Jurečić, Vilko Žiljak. HIDDEN INFRARED GRAPHICS ON A PAINTED CANVAS // International Journal of Applied Physics, Vol 2, 2017 p18-23, ISSN: 2367-9034; [www.ias.org/iasas/filedownloads/ijap/2017/015-0003\(2017\).pdf](http://www.ias.org/iasas/filedownloads/ijap/2017/015-0003(2017).pdf)
- [10] Vilko Žiljak, Denis Jurečić, Branka Morić Kolarić, Darija Ćutić; SIGURNOSNI INFRACRVENI DIZAJN NA ODJEĆI U TURIZMU; SAFETY INFRARED DESIGN ON CLOTHING IN TURISM // 5th International Conference Innovation, Technology, Education and Management; 2018; Sv. Martin na Muri; pp. 154 - 159; UDK: 677:338.488

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