

Design on canvas with infrared dyes

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Abstract: We respect NIR security cameras that have been installed in the city all around us. We have developed a new fashion design for two spectral areas: visual and infrared area. The canvas has been dyed with “twin” dyes, with two mutually independent designs, at the same place. Twin dyes have the same color tone for the visual area and those two dyes are being differently manifested on 1000 nm in the narrow infrared spectrum. The second design is invisible to the naked eye, it is hidden and available with the NIR security camera. Twin pairs for connecting two pictures and for printing in digital print are being given in the paper.

Key-Words: Infrared print, infrared painting, CMYKIR, twin dyes, NIR design on canvas

1 Introduction

The state of technology in the safety city area is based on infrared cameras. There are one hundred thousand installed cameras in Zagreb, both private and municipal. The reason for this paper is an INFRAREDESIGN[®] (IRD) idea which is based on creating double pictures on clothes. The cameras are going to differentiate the dresses designed in a planned way that carry different information for two separate spectral areas. Complete IRD procedure uses simple color from the store. This paper shows the hidden infrared image states, and therefore we call color “infrared colors or infrared dyes” (as indicated in the title).



Fig.1 NIR cameras on traffic intersections

Experimental papers have been published as tests on fabric [1], silk [2] and leather [3]. The first papers of hiding the double picture, with a subtitle IRD have been applied on documents [4] and cardboard packaging [5]. The theory of connecting two pictures for two spectral areas has been shown in the paper [6] of a group of authors from the Faculty of Graphic Arts in Zagreb. Mathematical models of managing with dyes for digital print have been developed in four forms [7] with the adjustment to different toners, inks and offset print. Printing techniques with application to document print have been discussed in that same paper. Printing technology on DURST plotters of big format with dyes that are stable in washing, related to temperature activity and dry cleaning has been applied in this paper. For each dye we are observing their separate absorption properties of narrow infrared light (NIR or IR) from the light absorption inherent to our naked eye.

2 Twin dyes

Each color tone is being derived in digital print in two different compositions with process dyes for digital print: Cyan, Magenta, Yellow and Black. The first dye composition, called V (visual) does not have positive absorption properties of NIR

radiation. The second dye (which has the same tone as the first dye) has a positive response of NIR radiation. In the paper the second dye is being called Z dye, and according to that also the camera that differentiates from V and Z dyes. We have introduced a measure of the absorption difference of NIR light at 900 nm called ΔZ . In the visual spectrum (400 to 700 nm) both dyes have equal spectrograms. The small difference between V and Z dye in the visual spectrum has been called ΔE [8] after a conventional colorimetric theory. We have introduced parallel recording of the visual and infrared content ranging from nature to art paintings. Such recording, such films are being called VZ as parallel observation, is studying of two substance states.

For the purposes of this paper we are showing spectrograms of two dyes (Figure 2) in the range from 400 to 900 nm. We have divided the NIR light area into two parts: Z1 and Z2.

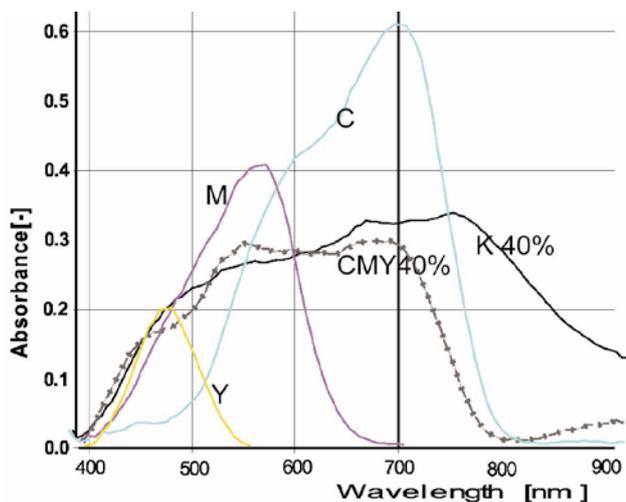


Fig.2 Spectrum of process colors C 100%, M 100%, Y 100%, K 40%, CMY 40%

Olive green and Ocher brown colors ($L^*a^*b =$ have equal ΔZ values. Their spectrograms are the same at the 900 nm position. That is targeted mixing of dyes in order to control the picture with Z camera. The light absorption graph shows the separation of twins of each dye after 700 nm. According to the settings of the conventional physics, the visual area reaches to 760 nm. This area is visible to our eye, but not as a color but only as the experience of a reddish color. Response of the yellow dye and magenta stops at 600 nm already [9] which is an important base in the process of mixing process printing dyes in order to achieve the desired RGB (red green blue) reproduction.

Table 1 Parts of color coverage

	V – C,M,Y %	Z – C, M, Y, K %	L^*a^*b
olive green	63, 42, 98, 0	39, 8, 84, 40	49, -21,49
ocher brown	42, 42, 99, 0	8, 13, 83, 40	58, -5,63

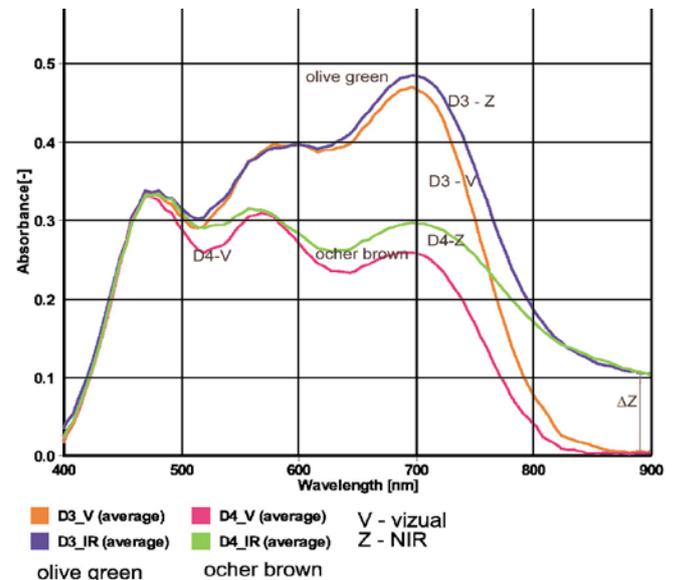


Fig.3 Twins of olive green and ocher brown

3 INFRAREDESIGN® on canvas



Fig.4 Dresses with Venice and Zagreb on the front of the dress - photos in nature

The hidden picture on the canvas is being demonstrated in the paper. The double picture is being demonstrated with the ZRGB camera live, as a film recording set up on a web site, and as a reproduction print in this printed article.



Fig.5 Back side (Venice)

Cameras for studying of IRD are blocked until 800 nm in order to increase the experience of extracting the infrared Z graphics.

Experiments with individualized dresses carry hidden information. The dress has reproductions of Venice and Zagreb. On the front page of the dress there is a picture of the panorama of Venice (visual) with the picture of the main square, ‘Ban Jelačić’ as a hidden Z picture. The back side is completely black. On that side there is a hidden Z picture of Saint Mark’s church in Venice which can be recognized with a safety Z camera.

4 Fashion design

Each of our ideas in the fashion form for canvas will carry a double image. The imitation of “Leopard skin” print carries hidden portraits of this paper’s authors. The beginning consists of two independent images that are being connected by IRD method. The technology of mixing dyes with printers with toners has spread to fabrics with stable dyes. The data base of twin dyes has been established by the experimental work on print with the purpose of creating invisible surroundings of

each reproduction that will carry double information in the sense of IRD technology. The parameters in regressive equations [7] have been experimentally confirmed with respecting the properties of dyes for technology of HP plotters of large dimensions.

Figure 6 shows the double content on the fabric. The first one, which is visual, and the second one in NIR print has been performed as a four-color CMYK print. A part of the image has been excluded and shown (Fig. 7) in the process channels after the CMYKIR separation [4].



Fig.6 Leopard print with double contents

On the [animation film](#) from Figure 6 dye properties shows RGB & CMYK states from 400 - 1000 nm.



Fig.7 Process channels C, M, Y, K from the first part of Figure 6

5 Infrared painting and reproduction of “NIR fine art”

New kind of painting has been opened by gaining knowledge on properties of dyes for art painting: A painting with a hidden double hidden picture. As the first step, paints have been studied: oil paint, acrylic paint, paints for ceramics. Spectrograms have been created for them so that the painter could control the deposition of paint to the canvas. Z coefficients have been determined for each dye, that is the power of sunlight absorption on 900 nm. On the [animation film](#) from Figure 8 dye properties of an art painting in individual blockages of sun spectrum are being disclosed.

Infrared painting is connected to IRD way of graphic reproduction to canvas. The aim of this procedure is to reproduce the image created in the IRPainting procedure, and for the reproduction to keep its originality in the sense of a “double, protected, hidden” art piece.

With this a new graphic reproduction is being introduced that respect painting in the visual and infrared spectrum. Original painting was created with paints for conventional art painting expression. The reproduction was created with process dyes for a printing technique.

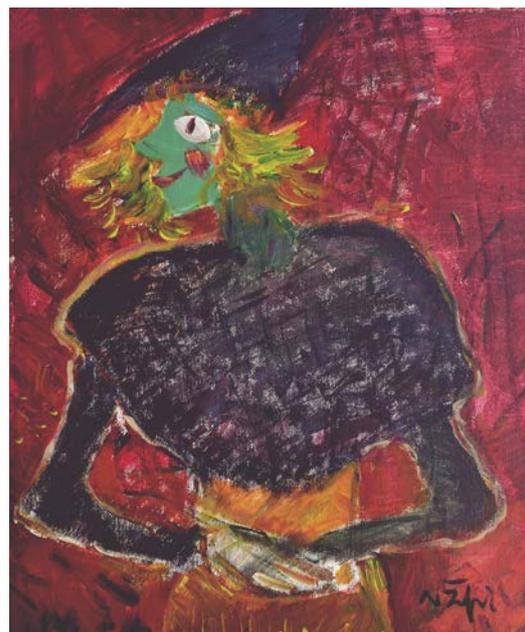


Fig.8 Double picture V & Z, acrylic on canvas, [animation film](#)

6 Conclusion

The new design technology (IRD) of painting (IRPainting) and reproduction has been developed. A method of connecting two pictures for the purpose of creating an invisible, protected, individualized graphic reproduced on fabric has been set up. A need for new findings on dyes has introduced us to the safety area in a new way. It is a development of application of infrared sun spectrum as a new way of designing clothes with managing dyes in a way to give to the reproduction in a sense of increased safety and safety of those who wear

such clothes. Presented methods are applicable on textile and leather and on art canvas. Further to the overview of this article there is a demonstration in real time with NIR cameras. This creates an obligation of presentation through a video, film and web technology that enables selective, barrier, forensic observation of our work.

Animation films:

<http://jana.ziljak.hr/Leopard.swf>

<http://jana.ziljak.hr/NadaMask.swf>

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