



Latest news

- President of the Republic of Croatia has visited HATZ
- Voted and formally recognized the new Statute of the HATZ
- Members of the HATZ awarded by the National Awards for Science
- "Annual 2009 of the Croatian Academy of Engineering" is published

New Technologies

Color Management Expansion on Infrared Spectrum with the INFRAREDESIGN Theory

At the beginning of INFRAREDESIGN (IRD) discovery, our research has mainly dealt with the "carbon black" color which has excellent properties in the near infrared (NIR) spectrum. Fortunately, precisely that color, marked by graphic artists as K, is used as a substitute for the same CMY (Cyan, Magenta, Yellow) application, whereby they are replaced. This is known as GCR (Grey Component Replacement), UCR (Under Color Removal) and UCA (Under Color Addition) separation system in the process of reproduction. We set CMYKIR (Cyan, Magenta, Yellow, Black, InfraRed) algorithm of separation [1], tested and applied to many materials and graphical representations of hidden images [2]. A general theory was developed with five set principles [2] on which CMYKIR separation is based. Each ton of color was associated with the continuous space of CMY and K replacement with respect to RGB settings and color settings by which are defined materials and properties of color penetration on material on which it is applied. The continuous space of CMY and K replacement allowed separation with information brought by the external image ignoring abovementioned GCR and other methods. Two information are merging as two separate images or as two pieces of information generated with computer graphics algorithm [3]. The method uses properties of CMYK (Cyan, Magenta, Yellow, Black) process colors continuously from value X_0 to X_{\max} [1]. In contrast to these four process colors, the industry uses a vast number of colors with custom mixed inks in many gradations. Their common name is spot color.

Two properties of matter: first; light absorption and reflection (A/R) from matter create experience of color in our eyes for wavelengths of 400 to 700 nm, other wavelengths are invisible for our eyes. Secondly; instrument can measure ratio of A/R light from matter and such information display as an image regardless of which wavelengths are present. Our focus is on the near infrared region. Visible region is described by three independent values in one of the systems, either RGB (Red, Green, Blue), or Lab (Lightness a b), or for example HSB (Hue Saturation Brightness). For the NIR region we are introducing the fourth value Z. Therewith we are suggesting the extended ZRGB space covering waveband from 400 to 1000 nm. It has



CAETS

CONTENTS

Color Management Expansion on Infrared Spectrum with the Infradesign Theory	1
Visit of the President of the Republic of Croatia to the HATZ	3
Higher Education Learning Partnerships – The Results of the TEMPUS HELP project	4
News – new Statute of HATZ	5
"Annual 2009 of the Croatian Academy of Engineering"	6
National Awards for Science	
Short CVs of the awarded HATZ members	
25 th Assembly of the HATZ	9
Short description of the HATZ Awards	9
Life Award	
"The Power of Knowledge"	10
Annual Awards	
"Rikard Podhorsky"	10
Awards to the Young Scientist	
"Vera Johanides"	10
Acknowledgements	10
Celebration of the 340 th Anniversary of the University of Zagreb and the Day of the University – 2009 th year	11
Short CVs of the promoted to the Professors Emeriti and awarded members of the HATZ	12
CAETS	14
Euro – CASE	16



An example of INFRAREDESIGN pictures (RGB and Z)

been proven that there is no correlation between Z, R, G and B values. This means that we can create an infinite number of RGB colors with same Z and same RGB color tones for different Z.

Our eyes don't perceive the Z value. It is measured instrumentally, and its A/R value is brought in our eyes with the IR camera as a grayscale image. It is possible to make an invisible graphic, which is manifested in a different waveband: invisible in the visible spectrum (VS) and visible in the NIR. And opposite result: visible in the VS and invisible in the NIR [4]. Color management that deals with wavelength range from 400 to 700 nm, we are expanding to 1000 nm and it also has implementation [5]. The outcome is new knowledge about mixing dyes, pigments, and about properties of absorption and reflection of light from matter.

Reviews, awards and public response

Coming out of the laboratory experimental conditions and revealing of the first results in scientific journals, conferences and dissertation defenses at our university, was testing of the set thesis on the management of dyes with intention of creating a double image. We obtained confidence to open a new door: we entered worldwide exhibitions of innovation and competitions in which we presented INFRAREDESIGN to the panel of top experts. They evaluate innovations according to several criteria, especially their impact on the practical applicability and potential market success.

Achieved awards and recognitions (www.infraredesign.net) from European metropolis via England, Germany, Romania, Hungary, Spain, Greece, to Russia, Taiwan, United States, Malaysia, India, and finally, Croatia, gave us confidence that the innovation is at the global level and it is completely original, practical and extremely valuable for today's state of



INFRAREDESIGN team. From left: V. Žiljak, I. Stanimirović, J. Vujić, K. Pap

technology and global market. These awards attract media, potential customers, but also ordinary citizens. Therefore, we had to customize IRD innovation for such a manner of presentation. International judges and their way of assessing and evaluating further influenced designing of the IRD technology towards better visibility and easier comprehension of the essence of the invention itself. That led to a new innovation of ZRGB apparatus with dual cameras.

With this apparatus the area of detection of absorption and reflection of light received a new value at laboratory and presentation level. It created a new way for further fundamental and experimental development aimed at research of properties of various materials, and specific reactions of flora and fauna in the near-infrared range.

Participation at the World Exposition in itself carries a level of security in terms of the invention. When we appear with different variations of our invention in the form of article, newspaper report, television show or presentations at international exhibitions of invention, we are consciously exposing ourselves to the judgment of world's intellectual, innovative and amateur public. It is essentially a primary test for the innovation itself, how much of its own strength as an idea does it have to be accepted by the broad scientific and professional milieu. We decided that the innovation itself becomes a brand name INFRAREDESIGN which is nowadays recognized both in the international scientific community as well as among common people. In Croatia IRD is recognized as a top national achievement, made here, conceived and theoretically explained. In all this, associations of innovation play an important role because through them we entered innovation exhibitions, but also colleagues from different universities and schools, and businesses that have helped in the implementation of expensive testing.

Courage to move in the direction of commercialization with our innovative idea would not exist if all mentioned procedures were not performed, from writing research papers to awards received at international exhibitions followed by media coverage and public recognition. IRD is such a powerful innovation that so far has no competitive ideas because of its easy recognition and detection by which protects itself throughout the whole time.

Some references of the authors on innovation Infraredesign

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