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SADRŽAJ

CMYKIR SEPARATION OF TWO PORTRAITS FOR POSTAGE STAMP DESIGN

Anastasios - Manolis Politis, Maja Rudolf, Jana Žiljak Vujić

1. Abstract

Based on extensive research conducted previously, a new design of postage stamp, with double image, visible and infrared, has been carried out and proposed with the innovative CMYKIR technology. This paper deals with the display of two graphics in a wide spectrum from 400 to 1000 nm. Due to limited physical space and dimensions of the postage stamp, different graphics are algorithmically mixed and printed as one image on the same sheet. Two images are detected with infrared camera. This technique enables richer graphics on stamps, cleaner design and adequate level of protection. Methods of design and processing of such images are extended and their composition is adjusted for application on postage stamp. In this study, we have introduced CMYK channels of the new graphic which contains one visible and one infrared portrait. In processing of RGB input image, the method of desaturation is applied which occurs in the separation of parts of the portraits that have similar tones of color. This function is introduced because it raises the level of grayness for achieving a certain degree of optimization of the contrast of input graphics, enabling and enhancing the results in the CMYKIR separation.
Keywords: postage stamp, dual portrait, CMYKIR separation

1. Sažetak

Na temelju opsežnog istraživanja koja su ranije izvedena, novi dizajn poštanske marke, s dvostrukom slikom, vidljivo i infracrveno, provedena je i predložena inovativna CMYKIR tehnologija. Ovaj rad se bavi prikazom dvije grafike u širokom spektru od 400 do 1000 nm. Zbog ograničenog fizičkog prostora i dimenzijama poštanske marke, različite grafike se algoritamski miješaju i tiskaju kao zasebne slike na isti list. Dvije slike se otkrivaju s infracrvenom kamerom. Ova tehnika omogućava bogatije grafike na markama, čišći dizajn te odgovarajuću razinu zaštite. Metode projektiranja i prerade takvih slika se proširuje, a njihov sastav je prilagođen za primjenu na poštansku marku. U ovoj studiji, uveli smo u CMYK kanale novu grafiku koja sadrži jednu koja je vidljiva te drugu kao infracrveni portret. U obradi RGB ulazne slike, primjenjuje se metoda desaturacije koja se javlja u odvajanju dijelova portretima koji imaju slične tonove boja. Ova funkcija je uvedena jer podiže razinu sivila čime se postiže određeni stupanj optimizacije za razlikovanje infracrvenog portreta od ulazne grafike, omogućujući i poboljšanje rezultata u CMYKIR separacije.
Ključne riječi: poštanska marka, dvostruki portret, CMYKIR separacija

2. Introduction

Postage stamp as a graphic product goes through specific phases of design that are developed and adjusted for its better / optimal functionality. It is a work of art in the same measure as a security graphic *[Ercegović, 1995]*. For that reason it has to contain rich and high quality graphics, typography and security elements. This dual function of a postage stamp is represented in its design. Issues of stamp design lie in placing all the essential elements into limited, small format, where none of the elements must not be neglected or reduced. Today's practice has shown that in designing a postage stamp one element is always emphasized at the expense of other elements. Examining the modern postage stamps *[Jukić, 2011]* it is evident that designers rely on rich graphics, neglecting the typography or protection. Typography here is especially neglected, because there is not enough focus on selecting the fonts legible on small sizes and sometimes the text is reduced to microscopic measures. Security elements today are standardized, mostly known to public *[Šinko, 2008]* and it is considered that their function is diminished.

There are many ways to protect a security graphic but most of them deal with special and expensive materials and processes *[Brigham, 2009]*. In the spirit of new inventions and technologies in graphic industry, postage stamp appears as an ideal candidate for implementing such a technology. This technology is known as Infraredesign, which takes effect in expanded spectrum of wave lengths, creating double image in visible and infrared area without the necessity for extra printing processes; Normal process or spot inks are applied.

The present paper is the extension of research that had begun in this area *[Rudolf, Koren, Vujić-Žiljak, 2012]* and it tries to expand former experiments through

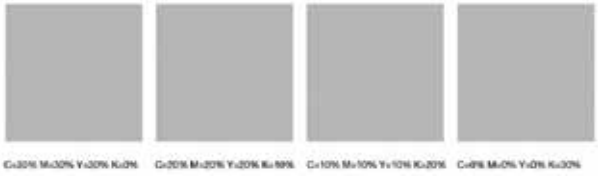
printing of postage stamp with double portrait.

3. Experimental part

In the experimental part we have conducted design and prepress process of one postage stamp which contains two portraits; one to be visible with naked eye and one visible in near infrared spectrum. Such postage stamp satisfies artistic and functional criteria and in addition it is possessing top-grade protection against counterfeiting. The format of 3 x 3.5 cm contains two full dimension portraits and typographic parts that have good readability. The postage stamp is adequately protected, through the specific processes in prepress, which takes certain pixels of the image, and ppplies them through mathematical algorithms that are specific to the type of printing process *[Koren, 2010]*. These algorithms are unknown and non visible to the printing worker/technician that performs the printing process; therefore it cannot be modified in any way. One part of the image is visible with naked eye but it contains and hides the second image which is visible only with an infrared camera. This kind of approach to design is based on the invention of Infraredesign and the respective theory and application developed *[Pap, Žiljak, Vujić-Žiljak, 2010]* that deals with image reproduction in near infrared spectrum. Thus we have gained double space in one format for designing graphics. New phases are introduced in designing and manipulating graphics for printing.

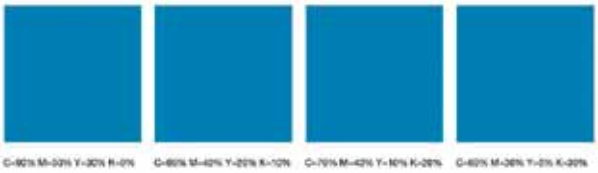
3.1. CMYKIR channel separation

In preparing images for reproduction in visible area, the first step is the processing of input RGB image. Additive RGB colors that we use to describe the picture in our eyes correspond to subtractive $C_0M_0Y_0$ colorants which are used in printing process *[Žiljak V., Pap, Žiljak I., 2009]*. Pigments which produce inks such as cyan, magenta and yellow have no response in infrared area of 1000nm. It means that an image printed with these inks is white when viewed through infrared camera. By adding the black component in standard CMYK inks, the infrared effect can be accomplished.
One tone of the colorant in visible spectrum can be obtained with mixing different percentages of C, M, Y and K components. Also, same amount of C, M and Y produces gray colorant, which has a same coverage percent as its components. This gray part in every color can be replaced with the black component K. Picture 1. shows four visibly equal gray tones of 30% coverage with gradual addition of black K, and equal subtraction of C, M and Y values.



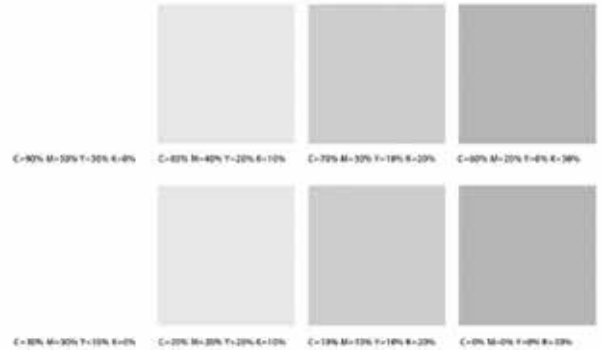
Picture 1. Simulation of the gray tone visibly equal, but with different percentages of C, M, Y and K components

The same principle is applied when mixing different percentages of each component. Picture 2. shows a blue tone with different amounts of CMYK components. whereas the percentage of K gradually increases by 10% from left to right. In the same proportion the C, M, and Y are reduced, until one of them reaches its minimum of 0%. The simulation of theoretical ink mixing is programmed and rendered in PostScript interpreter. All tints are visibly identical.



Picture 2. simulation of 4 visually equal tones with different amounts of CMYK components

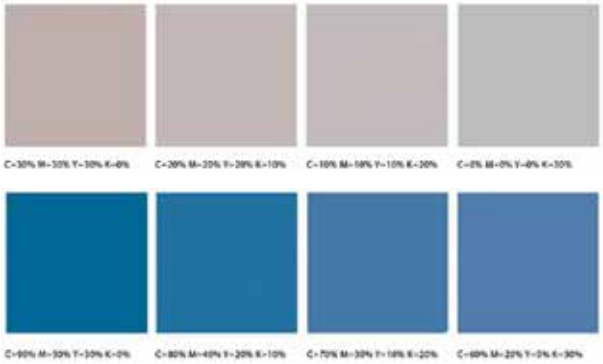
Four visually equal tones on picture 1. and 2. will show equal response in, ie. black coverage in infrared area. Picture 3. shows simulation of expected response under infrared camera for equal tones in visible spectrum. Because gray and blue tone have the same gradual increase of black component we obtain the same effect (same amount of black response) in infrared part of the spectrum.



Picture 3. Amounts of K component in tones from picture 1. and 2. produce different black coverage in infrared spectrum

CMYKIR separation is based on premises that black (K) component has an infrared response and that it can be controlled in every tone of color. When separating CMYK channels for printing we have to consider the effect that the ink produces in infrared area.
In practice we cannot obtain equal tone with just proportional adding and subtracting of C, M, Y and K components. Because of imperfections of physical

pigments in inks and their interaction with the substrate on which they are printed (e.g. paper), unevenness of tones can be more or less visible. The practice shows that when mixing equal amounts of C, M and Y, we do not always get clean gray tone, but different tones of brown. Picture 4. presents simulation of gray tone that is mixed with real CMY components in standard Photoshop color profile. As in previous examples black component increases by 10% while C, M and Y are equally decreased. The example shows coverage of gray by 30% obtained with different amounts of CMY and K. It becomes obvious that there are drastic deviations from the expected gray tone in the example with K=0% and K=30%. Similar deviation is visible in example with the blue tone. In tint with larger amount of CMY and less of K component, the visual experience of color tone is richer and the colorant is more saturated, although theoretically it should be equal.

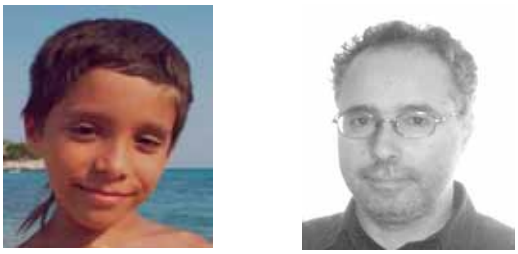


Picture 4. Simulation of realistic mixing of CMYK components

Because of deviations of real inks from theoretical mixing of colorants, CMYKIR separation introduces coefficients of color mixing which are gained by numerous measurements of real inks in real printing conditions. In other words it means that when changing the printing process we must also change algorithms that define CMYKIR separation. A known issue, which is encountered in CMYKIR separation, is a decreased saturation of color tones which occurs because of the larger amount of gray component. With our experiments we are able to define new ways to optimize the contrast of input image which includes an infrared effect. Postage stamps today are printed in offset printing method and extensive measurements need to be done which will result in the best quality of prints with double information.

3.2. Phases of double portrait design

In designing a postage stamp with double portrait we have to pay special attention to planning the motif which will be visible in day light and the motif to be visible in infrared spectrum. Visible image is carried out in color and infrared image as a black and gray image. The two images must be adjusted and set up the amount of optimal addition of gray component. Images must be adjusted in saturation so that colors would appear richer after the addition of gray. Images are harmonized in a way that the values of gray amount for each pixel is increased up to 20% from original tones. In that way the infrared effect can be obtained. Lower tones of the image are increased, but high tones are left as they were in original image. The dynamic range of tones is decreased and therefore the image shows lower contrast but the infrared effect can be achieved with larger response. In phase of image prepress process, the design of motifs is executed with software for editing images and it corresponds with conventional image prepress processes.



RGB ulazna slika Crno bijela ulazna slika

Picture 5. RGB input images with decreased contrast and gray image as "Z-graphic" for infrared effect

Picture 5. shows two portraits which will overlap in visible and infrared spectrum. Parts of the image with the same color tone in visible spectrum must produce different absorption of light in infrared area, which result in different gray coverage. A new phase of design is introduced in which the RGB and gray images are translated to CMYKIR channels, containing visible and infrared information in one reproduction. By the theory of CMYKIR, CMY values of CMYK channels are reduced to "minimum". Printed graphic separated with CMY channels with K=0% in infrared spectrum doesn't produce response, ie. it is "IR white - blank". The addition of the black component K from the information of second "Z graphic" and the respective subtraction of adequate amount of CMY components, enable one tone of color with different absorption of light in infrared spectrum. Maximum of black (K_{max}), which one tone can receive, is determined as the lowest value of CMY components. The black part of one tone can obtain any value between 0 and K_{max}. As a result, we can achieve a response in infrared spectrum from zero to that particular maximum. The CMYKIR separation is based on an algorithm which calculates new colors with infrared response on the basis of combining CMY(K=0) data and input values from Z-graphic. In picture 6. we can see the result of CMYKIR separation. For every pixel, new values of

CMYK mixing are calculated to obtain desired graphic in infrared spectrum. Only the K channel shows what it will be visible under infrared camera.

C kanal M kanal Y kanal K kanal

Picture 6. CMYK channels after CMYKIR separation

3.3. Application on postage stamp

Designed postage stamp has additional information in the form of text with name and surname of the person in the visible part of the graphic. This text is also visible in the infrared area, as it is shown in picture 7. Infrared image shows overlapping of two portraits in one part of the image. Such intrusion of visible image into infrared happens because in bright colors it is not possible to achieve adequate amount of black for the desired infrared effect. For that reason it is very important initial planning and positioning of the two graphics. The tone levels must be adjusted so that the best result could be achieved. Planning and positioning implies that dark tones of visible image would correspond to the greater response of second image. Higher tones of visible image should be matched (if possible) with white response in infrared image. For postage stamp design, it is important that the coloration of visible image is not drastically changed. The image for infrared spectrum gained elements from visible spectrum. That could be a positive element in the case of possible attempt of falsification. The area for placing graphics is increased. This designing method provides double amount of information on a small format. Typography has enough space for optimal readability. The most important part is that the one image protects the other one.

Picture 7. Printed sample of postage stamp with double portrait in visible(left) and infrared (right) spectrum.

4. Conclusion

Double graphic in visible and infrared spectrum is carried out with two portraits on a postage stamp. Although both images/graphics are printed on the same physical space, every portrait is visible in different wavelengths. The first one (colored) is visible with naked eye in visible part of the spectrum, while the other one (black/grey) can be visible only in the near infrared part of the spectrum. With such design, the technology of security printing for postage stamps is extended in the way that one graphic protects the other from copying and modifications. To understand this new method in use of CMYKIR technology, we have shown the phases which graphics go through in the prepress process. In addition we have presented the theoretical base of CMYKIR separation which enables the creation of double information in one image. This is achieved with a new function of increasing gray tone in brighter parts of the visible image. The design of graphics is adjusted for printing on postage stamps and the printing process is carried out on original paper and ink that are used to print regular postage stamps in the Republic of Croatia. Our intention is to apply this technology on numismatic securities with the goal of increasing the security level and to facilitate the authentication of postage stamps. We encourage further exploration in the direction of improvement of graphics quality and optimization of contrast of input images with the expected infrared effect.

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THE ROLE AND SIGNIFICANCE OF A DESIGNER IN POSTAGE STAMP DESIGN WITH INFRARED GRAPHICS

Maja Matas, Anayath Rajendrakumar, Jana Žiljak Vujić, Ana Hoić

Abstract

The representative graphic product „Postage Stamp" is based on a new design and manner of printing. The designer includes the InfrareDesign® method based on visualization in two specters: the visual and the infrared. The second image provides additional information in respect to the picture we observe with the naked eye. The designer has the possibility to draw the attention of the public and point out how everything has double a meaning, to make one think and observe that there is another story behind the set one. And the designer can do this in his own manner. A new technology is set before those involved in graphics: to develop printing methods for IRD reproduction of multilayer, double and hidden pictures on postage stamps.

Key words: design, double graphics Infrared technology, postage stamp, CMYKIR separation

1. Introduction

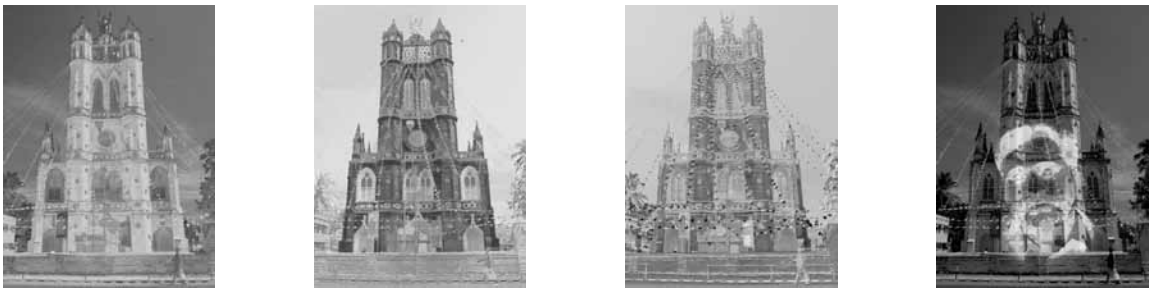
When defining design there is a accent put on the elements of choice and organization according to the aesthetic principles and with the goal of achieving a unique entirety for a certain purpose. The graphic industry has been undergoing changes throughout history, largely since the time computer technology was introduced, but the designer has always tried to carry out graphic tasks in such a manner that he would improve a product, and not only the product's visual quality. A designer consciously and appropriately determines an overall quality and the relation between the product and his user and his environment. He always has to meet the set parameters but he also has the need to add his signature, hidden elements that set him out in comparison to others. There are many such examples in history; one example is the banknote where it is often the case that by folding it in a certain manner an image is obtained that is not obvious in its ordinary use. Contemporary IRD technology makes it possible for print-makers to follow designs and place a hidden image inside a visible image; one that can be observed in other wavelengths. One of the images is in the 400 to 700 nanometer spectrum visible to the naked eye, and the other is in the 800 to 1200 nm infrared spectrum *(Žiljak V., 2010)*. The possibility of double visualization today makes way for better graphic designs, and the designer has an elegant option for designing multy-layered information presented then to the public *(Pap K. & all, 2010)*. Aesthetic sensibility is an important requirement that a good design needs to meet. A designer can design a product on basis of his acquired and subjective experience in such a way as to meet the set parameters as well as to make it be in accordance with his personal vision.

2. Infrared Dual Graphics on a postage stamp

Postage stamps are small in size but it is desirable that they contain lots of information. Therefore, it is interesting to design them with the help of infrared printing offset technology that allows several pieces of information to be in the same spot, but independent as to their visual side and linked as to contents. The same postage stamp can contain cultural information, characteristics of sovereignty and information on the event from the time period the stamp is dedicated to.

R G B

Picture 1. Kerala church photograph contained in the postage stamp and the RGB separation of the photo



C M Y K

Picture 2. Photograph of te church in the conventional GCR separation

It is planned for graphics in the infrared spectrum to be such that could irritate the user. It should also be stressed that the designer is given a tool for protecting his author's rights in a completely new manner. A very complex task has been left for the printers and that When the picture with the hidden message is scanned it is converted into the RGB system. The information created through CMYKIR separation disappears, because the RGB system does not recognize a multiple record for the infrared spectrum.

C M Y K

Picture 3. The infrared CMYKIR separation method where the exterior portrait picture has been inserted

is to include new knowledge into infrared technology because this will be required by the publishers, collectors and the designers themselves.

The postage stamp in picture 1. contains a photograph of the church in the state of Kerala, India. The conventional separation of the RGB image with the church using the GCR method *(7. Kiphmann, 1997.)* is shown in picture 2.

The CMYKIR (Cyan, Magenta, Yellow, Black, InfraRed) separation algorithm is set *(Žiljak V., Pap K., Žiljak I. 2010).* Each color tone is joined with a CMYKIR space for CMY exchange. Channel K is set in advance as a portrait. Subtracting CMY is subject to the requirement that the new CMYK states must carry information on two images. The first piece of information is that the church is ready for being observed with the naked eye and the second one will be seen with a tool that can observe the black channel separately. Neither image obstructs the other one. They go well together and are decomposed in any spectrum, especially in the VS and the IR. The black channel has a response in the near infrared spectrum. The image is a portrait. Two pieces of information are merged as two independent pictures created on the basis of a computer graphic algorithm. The infrared message is not observed by the conventional scanner. The portrait in the reproduction is not directly linked to the church. However, the stamp's designer has merged those two photographs into a whole because he connects the idea of India with his personal experience : the church he had observed there and his friend from India. By merging the CMYK channels from Picture 3 only the visualization of the church is visible, as if there is no portrait anywhere at all. On the contrary, the infrared camera at 1,000 nanometers observes only channel K, the carbon black colorant.

3. Display of the historical and cultural contents with the help of the infrared spectrum

The designer's role is huge because he is the carrier of the task and has the power to make a design on the visual level that meets the set parameters, and on the hidden level he can make his personal contribution. The task is often such as to display something inappropriate for showing in the street, or is not suitable for children to see. In such a case it is possible to design multilayer information and use it as an excellent way of communicating. The hidden layer is visible only with an infrared camera, and such cameras are all around us, especially with the growing

surveillance taking place in the very streets of our towns. There are cameras in nearly all public places, such as hotels, shops, hospitals, schools, private firms even in homes, and this is not necessarily in urban areas only. The double graphic may be used in different ways, the second picture that can explain the first one in a better the way, i.e. as an additional explanation. For instance, the first picture is a work of art and the second picture – the portrait of the first picture's author. The second picture additionally explains the first picture in the historical and cultural sense, and so this kind of design may find wide application for tourism purposes. For instance, if the hidden picture shows a photograph of a certain building, it can describe what has been in that certain spot previously, i.e. using double information to show how things were if we went back in time.

More than ever before in history we are surrounded by information on a daily basis. We could say that we are bombarded with visual information, and each individual person owns a personal gadget making one even more available and present. The Internet that has made all of this possible and provides such accessibility has also changed the way we function in everyday life. Man has acquired a new need to access this information base and this need is growing. Information available to the public is often manipulated in order to provoke certain reaction. For instance, the situations that have been shown to us by the media in one way are certainly different if told by the witnesses observing the actual events and experiencing them personally, or telling about their feelings and memories. However, the world we live in is not a simple one, and nothing is ever only black or only white; there are always several sides of one and the same story. A designer not only has the freedom, but also the duty to use the available technology in order to critically observe the world surrounding him. For instance, when the public is shown pictures of wars going on in faraway countries, soldiers are shown that perish in the struggle for a better life of the inhabitants there. It may be said that the visible picture has been chosen to make the atrocities appear less ugly, to give them a new meaning, but the hidden picture is a much uglier one and more brutal. On the other hand, some things are shown as catastrophes and they may not be as bad as they seem, and in such proportion as they appear to be.

4. Conclusion

The growing number of urban area street riots are the reflection of today's disturbed values, and there is a desire arising from this to form the environment surrounding us in such a way as to make each single individual aware about the problems encircling us. Double infrared graphics can be a very strong tool in encouraging the mass public's conscience and provoking critical observing. It is often the case that people do not have the skill to observe situations in a critical manner by themselves, but are stunned when something is revealed to them directly. A designer can draw the attention of the public by pointing out the double meaning of everything that surrounds us, by making people think and consider that there are different sides of a story and that it is not necessary to blindly believe in the information that are provided. Infraredesign opens a new way of handling hidden information where there is effort to speak about the same problem but in different languages. There is also a new task set before printers and that is to master Infraredesign technology as a new security method for postage stamp production.

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