

## Using Contemporary Painting Colored Lighting Style to Create Interactive Mural Designs with Colored Lights

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### **Abstract:**

Using colored lighting in paintings has been demonstrated by some of the contemporary painters like Ignat Ignatov and others, this paper is an extract from a thesis to apply the same lighting techniques on mural painting designs. This research aims to study the effects of colored lighting on a mural painting in order to create an interactive dimension with the viewer. Therefore, the research has been done to analyze the use of colored lighting and representation of light with paint, studying pigments limitation and how to overcome these limitations. The composition and lighting by prominent Egyptian director Shadi Abdelsalam has also been studied and analyzed as an Arabic and Oriental example of mixing light with color in scenes that can be interpreted as modern mural painting style and as a source of inspiration. Furthermore, studies have been done of modern color theories; most importantly subtractive color mixing, and the problems of traditional color theories, and how to utilize them to contribute with the technology to create a virtual interactive dimension with the viewer. For example, how the effect of colored lighting can change the color of a painting by subtractive mixing, and here comes the role of technology to link the interaction with the passerby when a passive sensor or camera detect them, it sends a signal to the lighting system to change, thus, the colored lighting changes and the shape of the painting or the mural changes too, and this can create a sense of motion, morphing, statement, or atmosphere. The experiment of the study is about paintings with pre-planned color schemes in the purpose of obtaining certain color affects when directing colored spotlights on that painting.

In conclusion, cross disciplinary collaboration between art painting and other fields like interactive mural design can provide a significant contribution for the Applied Arts and Design field with unlimited ideas.

### **Key words:**

Interactive Mural Design - colored lighting - Color Temperature - Meanings of Color - Wheel of Emotions

**ملخص:**

استخدام الإضاءة الملونة في التصوير قد تم استخدامه من فنانين معاصرين مثل اجنات اجناتوف وغيره من الفنانين المعاصرين, هذه الورقة البحثية هي مستخلص من رسالة لتطبيق تقنيات الإضاءة الملونة على التصوير الجداري. يهدف هذا البحث لدراسة تأثيرات الإضاءة الملونة على التصوير الجداري لإنشاء بعد تفاعلي مع المشاهد. ولذلك تم تحليل استخدام الإضاءة الملونة وتمثيل الضوء باللون, و معرفة حدود الصبغات في الألوان و كيفية تعويض ذلك. ثم دراسة التكوين و الإضاءة للمخرج المصري البارز شادي عبد السلام كمثال عربي و شرقي لمزج الإضاءة مع اللون و كمصدر للاستلهام في الأسلوب الحديث في التصوير الجداري.

علاوة على ذلك قد تم البحث في نظريات اللون الحديثة و خصوصا المزج الطرحي, و خلط الألوان و بعض المشاكل في النظريات التقليدية, ثم كيفية توظيف ذلك مع التكنولوجيا لخلق بعد تفاعلي افتراضي مع المشاهد. على سبيل المثال, كيف يؤثر الضوء الملون الموجه على العمل الفني عن طريق المزج الطرحي للألوان و كيف يتم تغيير الألوان, و من هنا يأتي دور التكنولوجيا لربط تفاعل المشاهد أو المار حينما مجسات الحركة أو الكاميرا تستشعر موقعه أمام العمل الفني فيتم إرسال إشارة إلى نظام الإضاءة لتغيير لون الإضاءة و بالتالي يتغير شكل اللوحة أو الجدارية, و هذا يخلق حس الحركة, التغيير, أو التعبير, و يعطي دورا للمشاهد في المشاركة في العمل الفني.

تجربة هذه الدراسة عن التصوير مع خطط لونية مسبقة لهدف الحصول على تأثيرات و تغييرات لونية محددة حين توجيه إضاءة ملونة على العمل الفني.

و ختاماً, الدراسات البيئية التعاونية بين مجال التصوير والتصوير الجداري التفاعلي و التكنولوجيا يؤدي بإسهام هام للفنون التطبيقية مع أفكار غير محدودة.

**كلمات مفتاحية:**

تصميم الجداريات التفاعلية – الإضاءة الملونة – حرارة اللون – معاني الألوان – دائرة المشاعر اللونية.

**Introduction:**

Color is Light, the colors come from light and by studying light and colors we can learn how to use colors to make design that interprets the meaning to the viewer. Alhassan Ibn Alhaytham (965-1040) who was "Considered to be the father of modern optics" <sup>1</sup> as UNESCO was celebrating the International year of light, has said that "The form of the color being always found together with the form of the light. And similarly with bodies that shine with their own light: their lights are found to be similar to their forms, which are of the same sort as colors" <sup>2</sup> Isaac Newton stated that the white light produces different rays of light creating a spectrum of colors when it passes through a prism, and vice versa.

Color looks clear and strong if the light is strong, whether if it's a white light on the colored surface, or a colored light. Ibn Alhaytham explained that the opaque objects of bright colors "when in obscure places or in feeble lights, look dull in color. But when they are in a strong light, their colors look bright and clear. As the light on them grows stronger, their colors increase in brightness and clarity. "

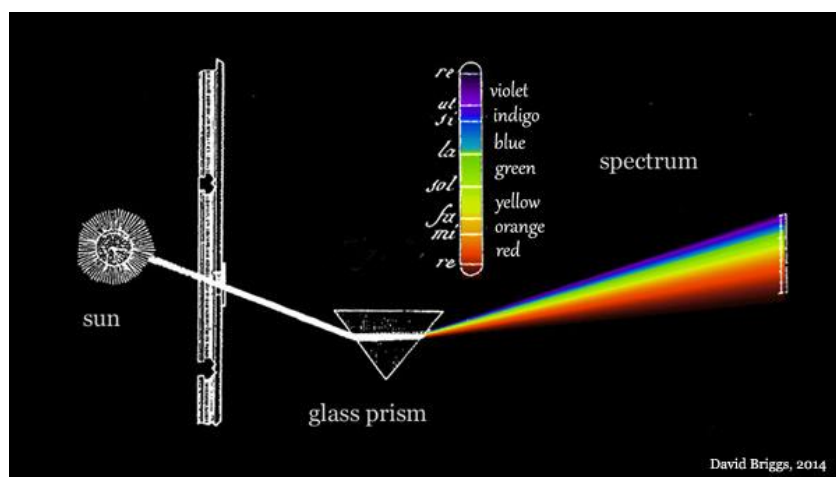


Fig.1. Newton's prism

In Addition, Isaac Newton stated "For the Rays to speak properly are not colored. In them there is nothing else than a certain power and disposition to stir up a sensation of this or that color. For as sound in a bell or musical string, or other sounding body, is nothing but a trembling motion"<sup>3</sup>So, it's the brain that translates all the signals from the wavelengths of the rays to colors or the frequency of sounds.

"Because we experience colors as mental perception, they can trigger elaborate memory associations, causing each of us to respond to them in a unique way."<sup>4</sup>

Now color vision theories have evolved and can be understood through three processes:

1-Trichromatic input: the responses of the three type of cone cells in the retina L, M and S. (Long, middle and short).

2-Opponent output: comparison among the responses from the L, M and S cones.

3-Colour Constancy: "refers to our automatic habit of interpreting local colors as stable and unchanging, regardless of the effects of colored illumination, the distraction of cast shadow, and the variations of form modeling."<sup>5</sup>

### Color temperature:

When we understand the temperature of color we can use it in art and design in a professional way achieving desired impact. "Color temperature is scientifically defined by CIE as: temperature of a Planckian radiator whose radiation has the same chromaticity as that of a given stimulus. Unit: K".<sup>6</sup>There is a difference between light temperature and the temperature of pigment colors: "The temperature of a light source is a definite property that it bears. Light sources can be described as cool or warm, or having a dominant temperature"<sup>7</sup> due to the wavelength that it radiates from the spectrum, and what it doesn't radiate. On the other hand color temperature" is definitely not an intrinsic property of a pigment; It's how warm or cool color looks to us compared to its surrounding colors"<sup>8</sup>and it's affected by the ambient light and the environment. "Local color is the color of an object unaltered by light or reflection. In other words, local color is the inherent color of an object."<sup>9</sup>

### The relationship of color temperature:

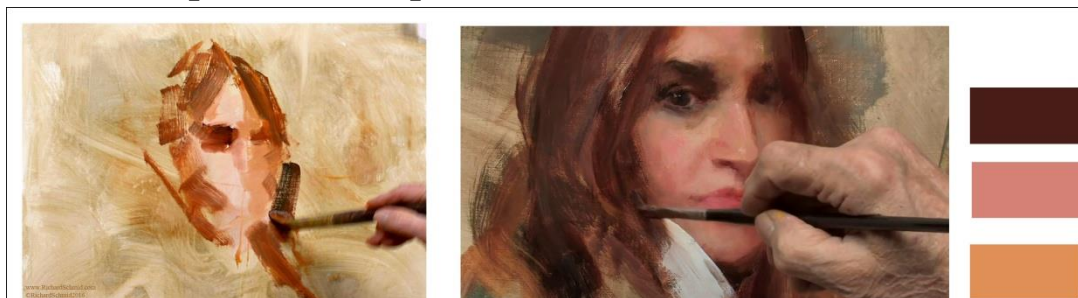


Fig.2. Richard Schmidt's painting, first stage and color swatches.

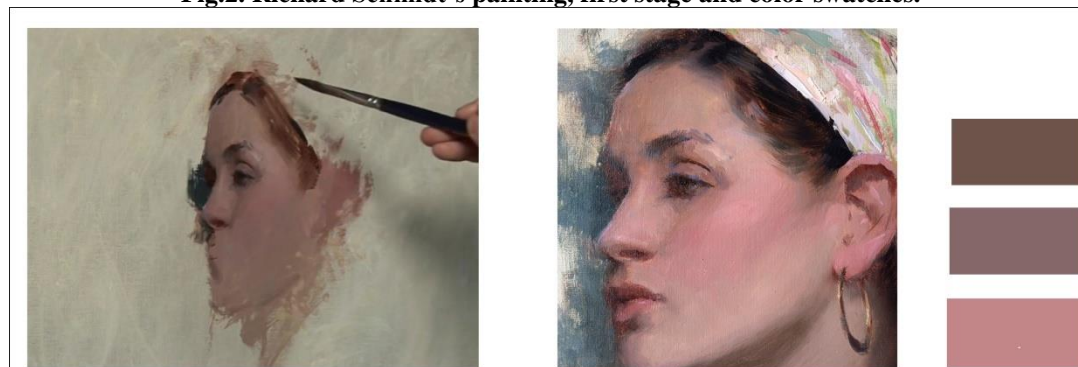


Fig.3. Jeremy Lipking's painting, first stage and color swatches.

"Alex Venezia explained that the relationship of warm and cool is what matters as in these paintings by Richard Schmidt (b.1934) and Jeremy Lipking (b.1975)".<sup>10</sup>For example if we look at Jeremy Lipking in this painting we will see he started with cool skin color and at the end we feel the colors are beautiful, on the other hand in Richard Schmidt in this painting he started with a warm skin color and at the end we feel the colors are real and make sense. The reason is the relationship between the warm and cool are accurate, for example how much the cheek is warmer than the forehead. "To sum this up we must see the relationship between colors, the relative visual warmth or coldness of colors to one another in a complex visual field of many colors."<sup>11</sup>

### Warm Light produces cool shadow conception:

There is a common conception passed through many painters indicates that a warm light produces cool shadows and a cool light produces warm shadows. "Light means color, and shadow is the absence of light meaning absence of color, thus the shadow has less color and is more neutral."<sup>12</sup>Hence a warm light beside a neutral shadow makes the neutral color appear cooler, and a cool light beside a neutral shadow makes the neutral color appear warmer. To understand the colors of shadows accurately it's important to consider:

### The factors of the color temperature of shadows:

- 1-Illuminated objects, surface characteristics, and local color.
- 2-Light sources (indoors, outdoors) and ambient light.
- 3-Surrounding objects and environment reflections.
- 4- Biological mechanisms of perception, color opponent process theory, and color constancy.

### Traditional colors problems in mixing paints:

Mixing the basic primary colors does not necessarily produce the accurate secondary color as we see it on the color wheel of Johannes Itten.

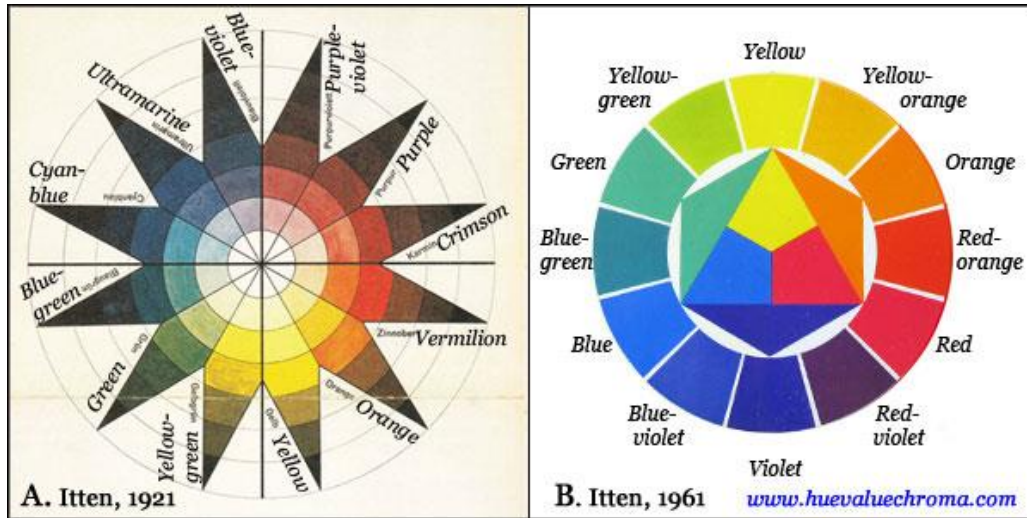


Fig.4. Color wheel in a star shape by Itten for his teaching at the Bauhaus in 1921 which is inspired from his teacher Adolf Hoelzel

"Although textbooks for academically trained artists ably explained modern color theory from its beginnings, traditional color theory persisted into the 20th century in other texts, especially those written for amateur painters, and in the thinking of other artists, notably some of the pioneers of abstraction (Kandinsky, Mondrian) and expressionism."<sup>13</sup>

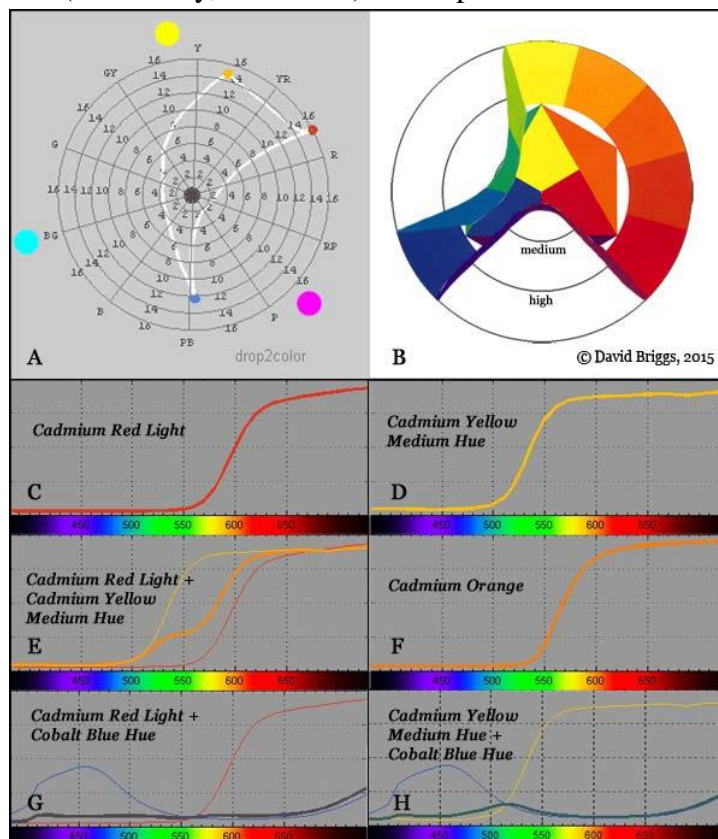


Fig.5



Fig.5. "A. Mixing paths of a set of red, yellow, and blue paints (Cadmium Red Light, Cadmium Yellow Medium and Cobalt Blue Hue. B. Itten's color wheel transformed to show Chroma of primary paint mixes. C-H. Spectral mixtures calculated using the program drop2color by Zsolt Kovacs Vajna."<sup>14</sup>

The problem is that Itten's primaries yellow, red and blue can't generate full Chroma colors on the whole color wheel. Only high Chroma mixture with his primary yellow.

Unlike primaries of Cyan, Magenta and Yellow.

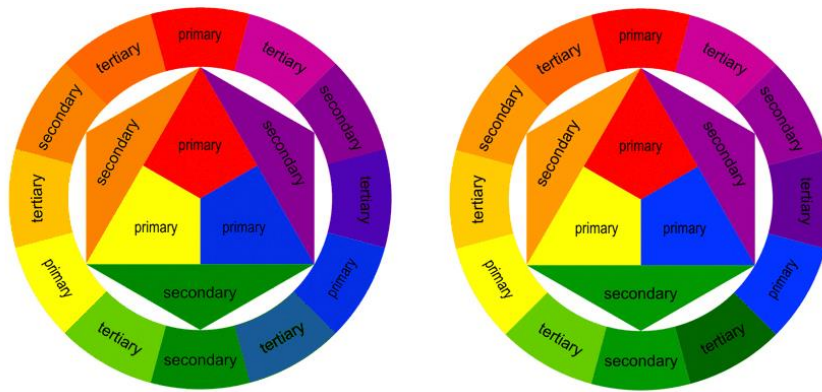
On the other side, artists and designers might find their way to get colors by talent or experience. In Egypt; Prof. Fathy Gouda has edited the colors that are used to mix secondary colors, by a lot of trials through teaching experience and through his Sign Boards Design and manufacturing, he changed some of the primary colors to get accurate secondary colors:

"Secondary correct green: Prussian blue + lemon yellow

Secondary correct purple: magenta red + cyan blue + ultramarine blue

Secondary correct orange: vermilion red + warm yellow

To get turquoise color : secondary green (described here) + ultramarine blue"<sup>15</sup>



Edits by F.Gouda

Original by J.Itten

**Fig.6. Edits by Prof. Fathy Gouda of the color wheel of J.Itten.**

The aim was to be able to find the right colors to get fresh and vivid hue like how we could see in the spectrum colors coming out of a crystal prism.



**Fig.7.Experiment to match real colors of the spectrum with pigments, Published Poster in Conference of AIC in the UK, 2013.**

In this experiment<sup>16</sup> to match the real colors of the spectrum a crystal prism was used to project the spectrum colors on a paper. Then matching the colors in intensity and accuracy with Gouache colors. The main goal was to mix colors regardless of Itten's classifications or others to get the accurate hues.

Yet Prof. Fathy Gouda's notes about color mixing was helpful in this process.

### The Meanings of Colors in Art:

There are different signs than can be interpreted from the colors used in painting, we will focus on the portrait, although the new contemporary school of art painting that we study here is not clarifying yet or showing any special symbolic or even semantics of the used color, except what can be interpreted as related to the color temperatures. And based on that, the color temperatures, we can find that some colors give heat or cold atmosphere. Thus we can interpret the heat to warm, or tender meaning, "warm colors make us think of fire, hot spices, and blood. They connote energy and passion. Orange and yellow are ephemeral colors."<sup>17</sup> And the cold to loneliness, or depressive meanings." "the color blue suggest quietness, restfulness, and calm."<sup>18</sup>

<sup>18</sup> Many signs can be interpreted by using the colored lights in painting and in real scenes.

The Color Wheel of Emotions by Robert Plutchik offers suggestions of different emotions that can be represented by colors, an artist and designer must be aware of the possibilities of meanings of colors to be able to use colors and colored light in the designs in order to give the right message of the concept of the work.

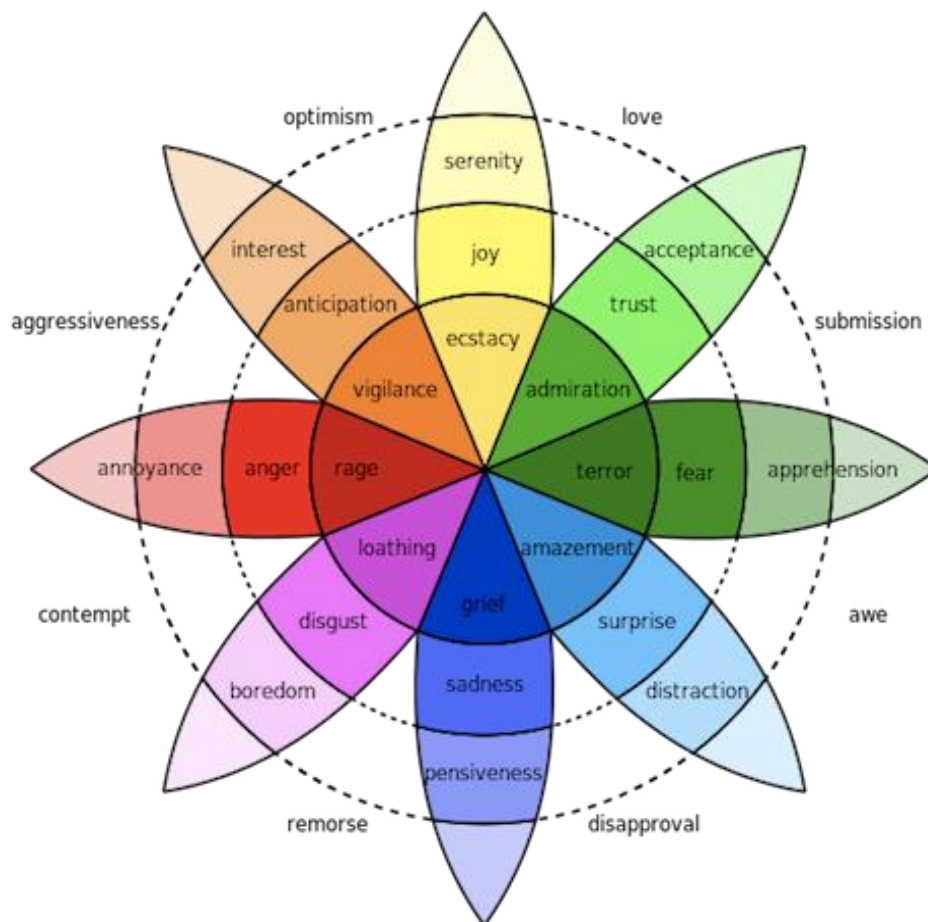


Fig.8.The Color Wheel of Emotions by Robert Plutchik

The website of the Ekman Atlas of Emotions <sup>19</sup>show a lot of varieties of feeling that can be interpreted through the use of colors in Art and Design.

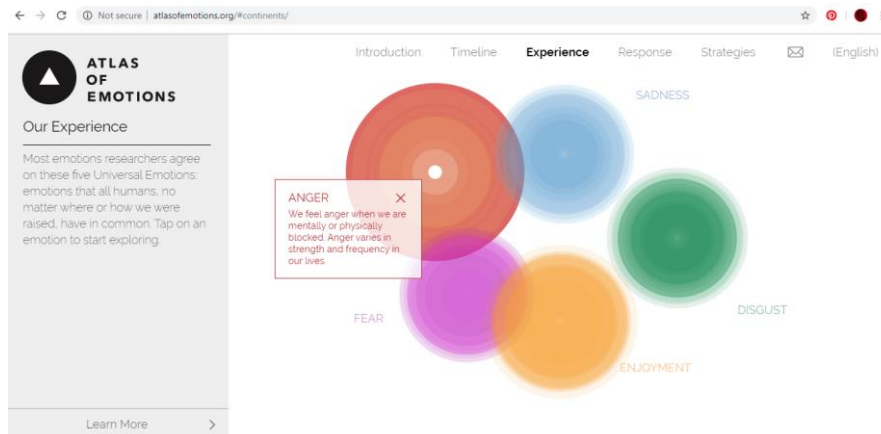


Fig.9. Atlas of emotions.

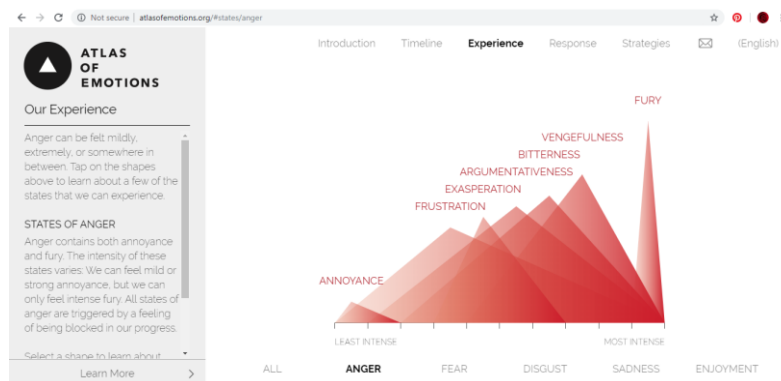


Fig10. Atlas of emotions, states of anger.

**The Case Study:**

**1- Composition and lighting by Shady Abdelsalam as an Arabic and Oriental example for a modern mural painting style:**

Shady Abdel Salam (1930-1986) was a prominent Egyptian director as well as a skilled painter who had a unique sense of lighting and composition for sketches and designs for his films.



Fig.11 Sketch for a film, Shady Abdel Salam, unknown size, Watercolor and pencils on paper, unknown year.

In this painting we can see the wide composition which has a glimpse of the ancient Egyptians murals in a modern way.



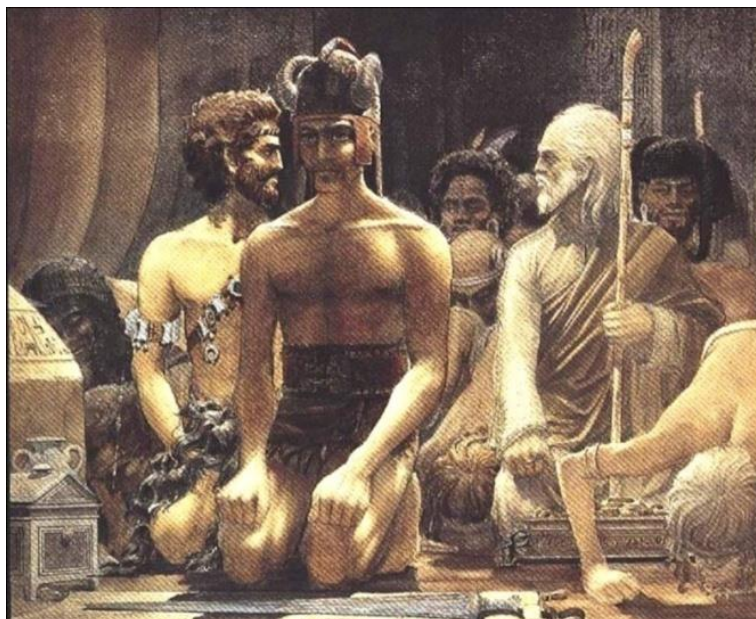


Fig.12. Sketch for a film, Shady Abdel Salam, Watercolor and pencils, unknown size, unknown year.

In this painting he used lighting from the middle of the scene, to give a backlit effect on the person in the front to obscure his details, and send focus on the person who is looking at the oracle. As well as the dark background to make a contrast with the faces to make them the focal point. Moreover, he used an earth tone palette to give a dramatic effect and a sense of the past. Although the lights look white or day light, we see they come from unusual architectural openings, and the light creates a colored dimmed atmosphere to the whole scene.

## 2- The use of Colored lighting in Painting by Ignat Ignatov:

Ignat Ignatov<sup>20</sup> is a prominent contemporary painter with a unique understanding and use of color and light. He uses colored lightings in many of his paintings.



Fig.13. Self-portrait in red lighting, Ignat Ignatov, with color swatches.

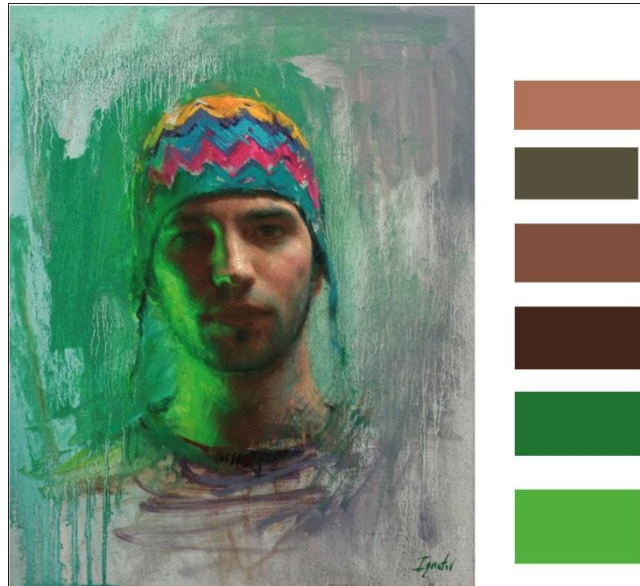


Fig.14. Self-portrait in green lighting, Ignat Ignatov, with color swatches.



Fig.15. Self-portrait in blue lighting, Ignat Ignatov, with color swatches.

"He used pthalo Green, Cadmium yellow and a little bit of white to produce the effect of green lighting. He used Cadmium Red Light and some Cadmium Yellow to produce the effect of red lighting, and for the blue lighting he used Pthalo Blue and white."<sup>21</sup>



Fig.16 This painting shows the sense of Kelvin scale for temperature in the lighting.

### Effects of colored lighting:

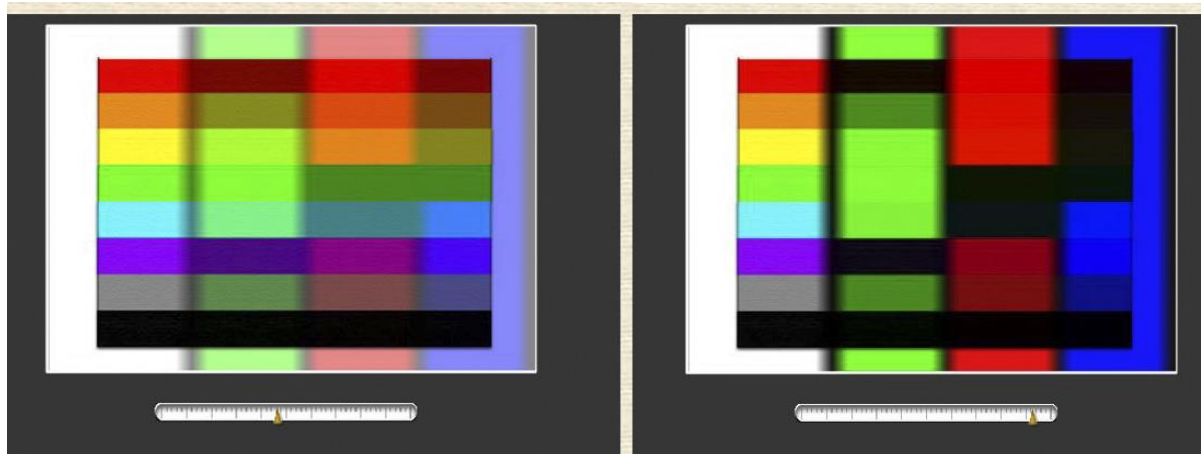


Fig.17. Effects of weak and strong colored lighting on other colors

"Color is not absolute, but it changes with the change of the surrounding lighting, accordingly the idea of the research is using the change of color by changing the light falling on it." <sup>22</sup>The effects of weak and strong colored lighting on other colors to help understand how the colors of the painting react to the colored lighting. "The effects of colored illumination follow the principles of subtractive mixing, since only wavelengths present in the light source and not absorbed by the surface can be reflected."<sup>23</sup>Colored lighting drop the Chroma and lightness of complementary colors making them darker and neutral, thus it increases the lightness of all the surfaces whose wavelengths are in the colored light hue. In Photoshop the effects of colored lighting can be simulated by an overlying colored layer in multiply mode, the opacity of the filter controls the strength of the effect of the colored lighting.

### Study of using technology to create a virtual interactive dimension with the viewer:

"Interactive design is creating a dialogue between the person and the product, system, or service. this dialogue is natural and emotional and shows us the interaction among shape, function and technology with time"<sup>24</sup>

For example, the action can be:

- Person's movement -Person's position –Music –Heat –Touch.

That can influence the mural to:

-Change shape or colors or change in a kinetic way.

Here are some explanations of using technology to create a virtual interactive dimension with the viewer:

1-RGB with colored lights that change the picture by subtractive mixing theory.



2-RGB with colored filters or glasses:

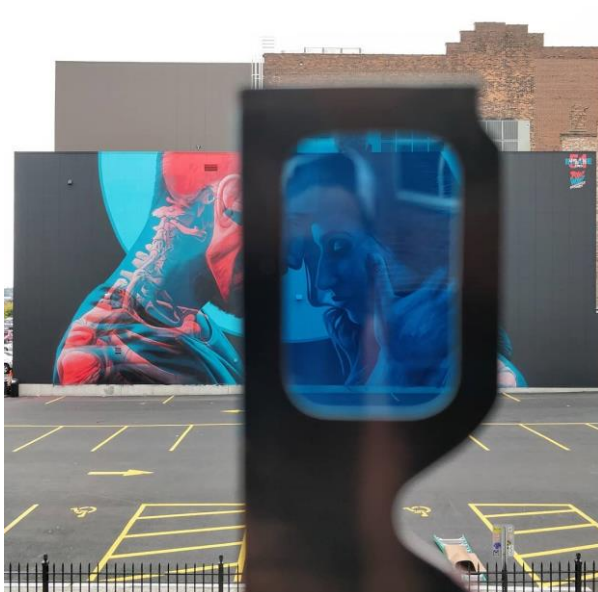


Fig.18. Mooncake, Insane 51, Massachusetts, USA,2019

3-Interactive mirrors (kinetic):

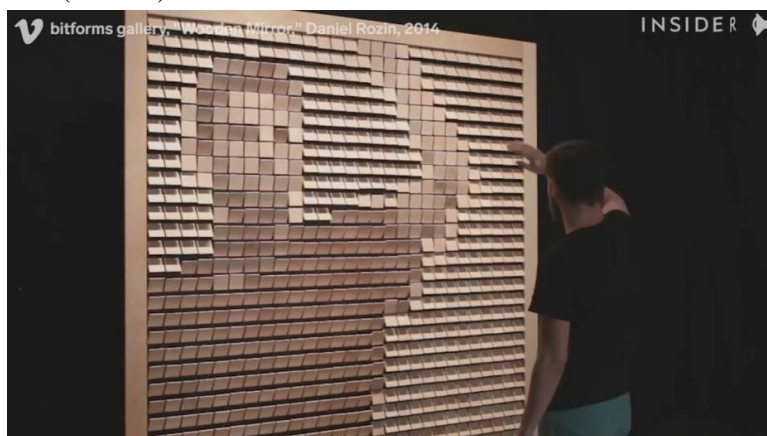


Fig.19. Wooden mirror, Daniel Rozin, 2014

4-Thermo changing with heat:

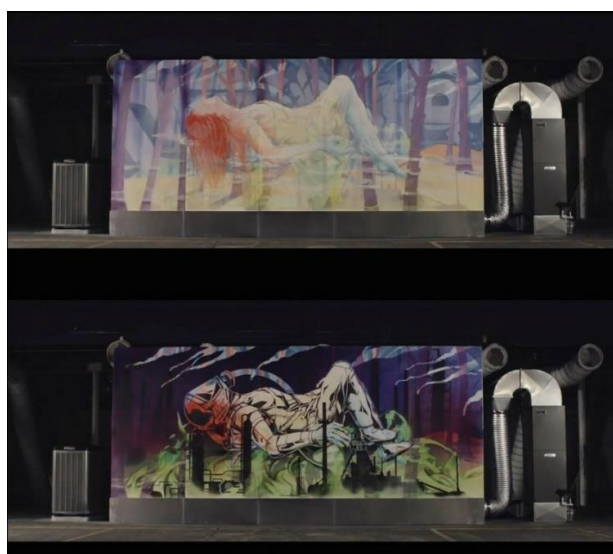


Fig.20. Purity, Dodo Ose, USA, 2016



5-Projection on murals (with changing music, or sensor) or "Augmented mural"



Fig.21. Parallel – Augmented mural, Nick Napoletano & Peter Godshall, USA,2019

"Sam Sykes built the custom stand, which holds a MIDI controller for viewers." <sup>25</sup>MIDI stands for Musical Instrument Digital Interface.

**Experiments of the study:**

**Experiment of the effect of different materials by indirect painting (or multi-layers):**

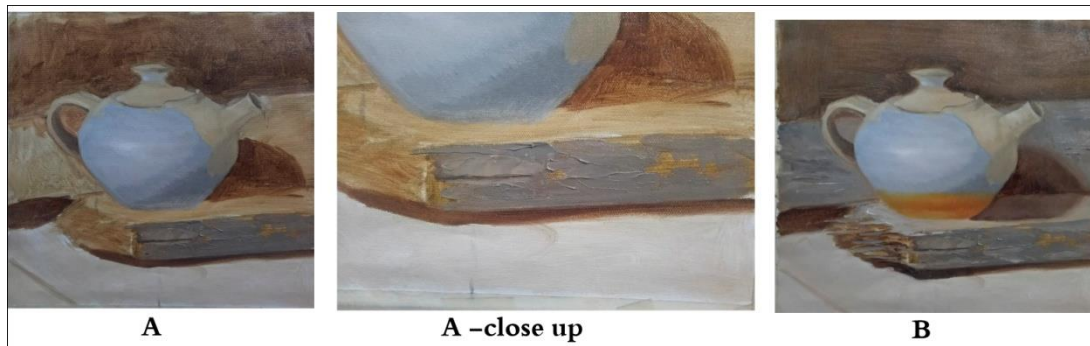


Fig.22. First stages of still life painting

A painting by the researcher<sup>26</sup>while attending an online workshop with Alex Venezia at East Oaks Studio<sup>27</sup>.He laid down a warm layer, then a cool layer in a patchy strokes to reveal some warmth from the first layer. As shown in A-close up, plus the balance of the warm and cool colors areas in the pot makes a good contrast.



Fig.23 The balance between warm and cool colors creates a luminous effect, a palette knife was used to lay down texture of the wood.

### Experiment of Dual light painting (warm and cool):

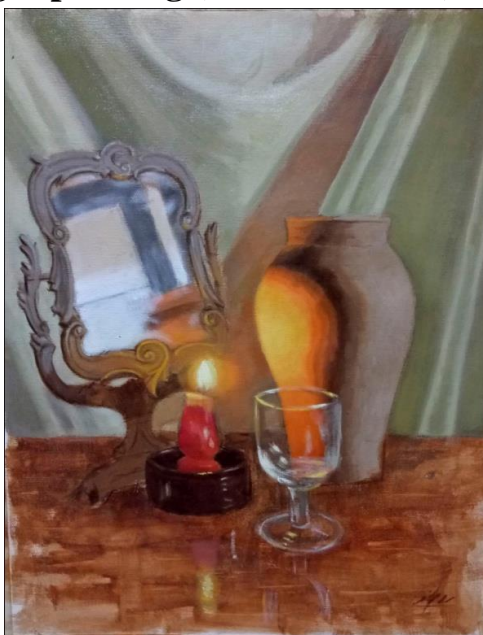


Fig.24. Untitled, by the third author of this paper, 50x60 cm, oil on canvas, 2019

The still life set-up is lit by a natural light window from the right which creates a cool effect, and a candle which gives warmth and reflection in all the surroundings, and affects the local color of the pot, the mirror frame and the background fabric.

### Study by copying a section of Sistine Chapel mural by Michael Angelo:

Stage one : drawing, The researcher<sup>28</sup> started with preliminary lines with charcoal to find the placement of the objects, and drew diagonals to help measure proportions and placement, as well as dividing the canvas into thirds. Stage two: the under painting was not monochromatic, the researcher massed the shadows with thinned washes with Turpentine to give the subsequent layers' depth and richness. Then painted the light areas lighter than they are, so that he can go



darker with transparent glazes in the subsequent layers, and this can give the painting a backlit effect and luminosity. Stage Three: The First pass: The researcher tried to get the colors and values more correctly, but at the same time applying colors in a more of semi-opaque way not opaquely to maintain the richness of the previous layers. Stage Three: The Second Pass: The researcher refined form, edges, values and details, as well as adjusting the color temperatures warm and cool.

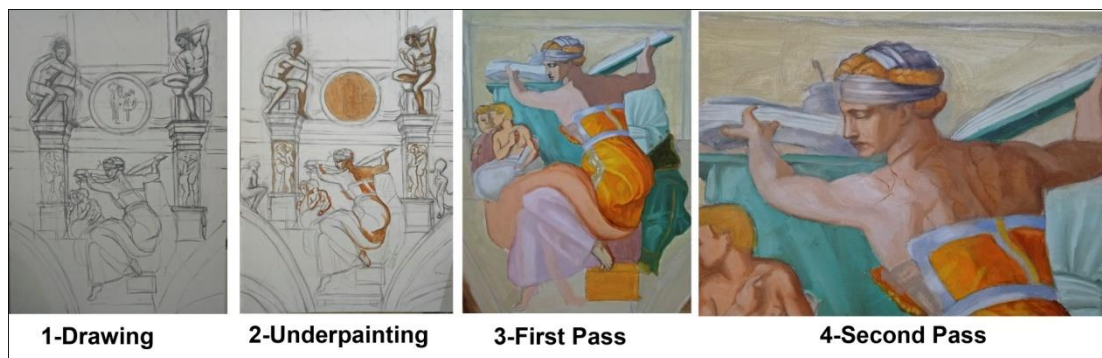


Fig.25. Stages of a copy by the researcher of a section of Sistine Chapel by Michael Angelo

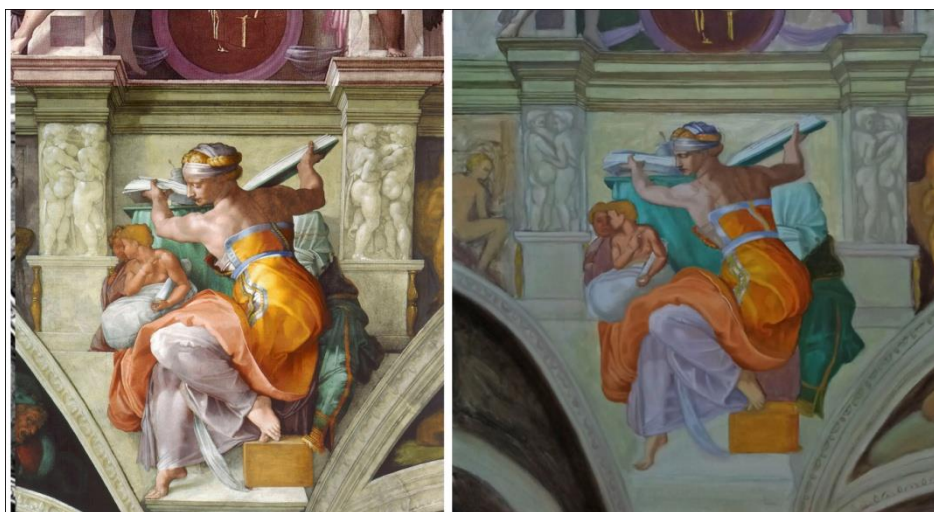


Fig.26.Right: copy by the researcher of a section of Sistine Chapel by Michael Angelo

**Study of copying of Shady Abdel Salam's Painting:**

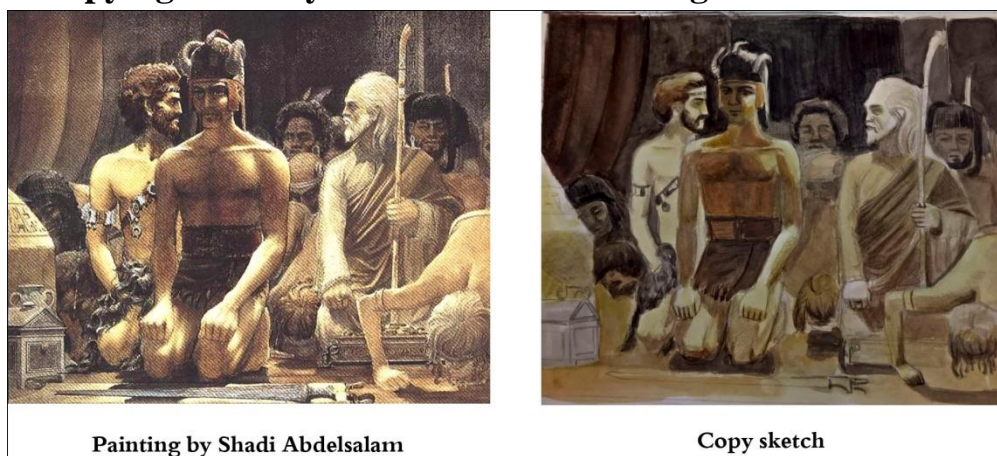


Fig.27.A copy sketch to study his use of color and light, besides his composition of multi-figures painting.

### Experiment of Paintings by Colored Lightings:



Fig.28. Self-portraits in colored lightings by the researcher<sup>29</sup>

Painting was in green and blue lighting, trying to represent the effect of lighting with pigment, which was challenging to do. In the portrait in blue lighting, he used Pthalo blue and white to get the vibrant blue, and some alizarin crimson for the terminators of shadows. While in the portrait in green lighting he used Pthalo green and some cadmium yellow plus a bit of white to get the green lighting.

### Experiment of painting by a limited palette (Zorn Palette) with some modification:

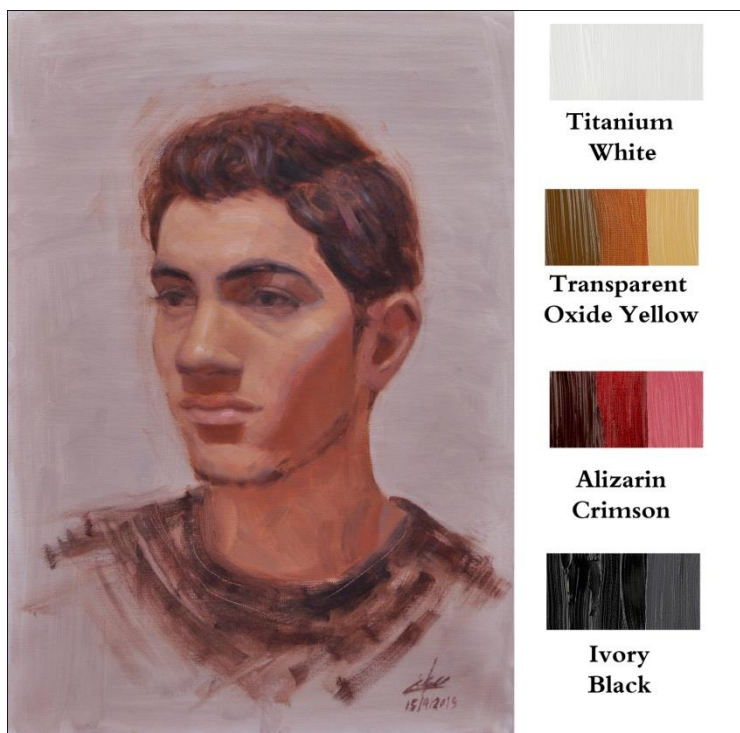


Fig.29.portrait in limited palette, by the researcher<sup>30</sup>, oil on canvas, 35x50cm,2019.

This is a painting with Zorn palette which is supposed to be "White, Cadmium Red, Yellow Ochre, Ivory Black). The problem is "These color mixtures are very opaque and it's easy to get mud," the artist says. Ignatov combated this susceptibility by keeping his brushes scrupulously clean and separating each color mixture on his palette." <sup>31</sup>but the researcher<sup>32</sup>modified it, and



used Transparent Yellow Oxide and Alizarin Crimson, these transparent colors to avoid getting muddy colors, but it was quite challenging to work with very transparent pigments and get the desired colors.

### **The Experiment of Mural Interactive Design:**

Concept: Face Mask; the concept of this Mural Design is to grasp the attention of the passerby in front of the wall of the Mural Design by changing the light based on the presence of the passerby, this is done by the sensors of movement. The regular view of the Mural Painting is under a cast of blue light of calm looking portrait of a young man, while a person passes in front of it, the light spots on the Mural changes by a full white not blue, and this shows the rest of the colors of the original Mural Painting, which reveals another face behind that anger trying to control this anger within.



**Fig.30. Monochromatic sketch, massing in shadow shapes**



**Fig.31. the design concept, oil on canvas**

**A painting has been done using a colored red lighting on a portrait, so that it can be canceled when we add a colored lighting like blue, or green, and create movement and statement.**

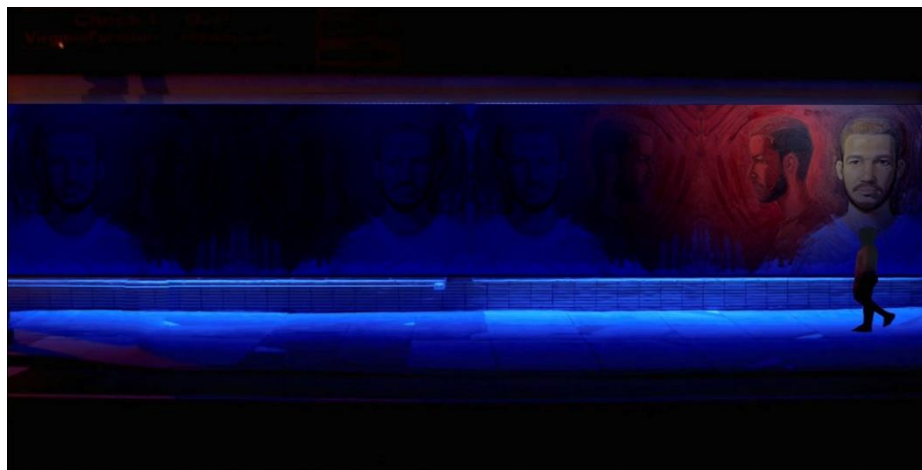


Fig.32.Simulation of the painting under the effect of blue lighting

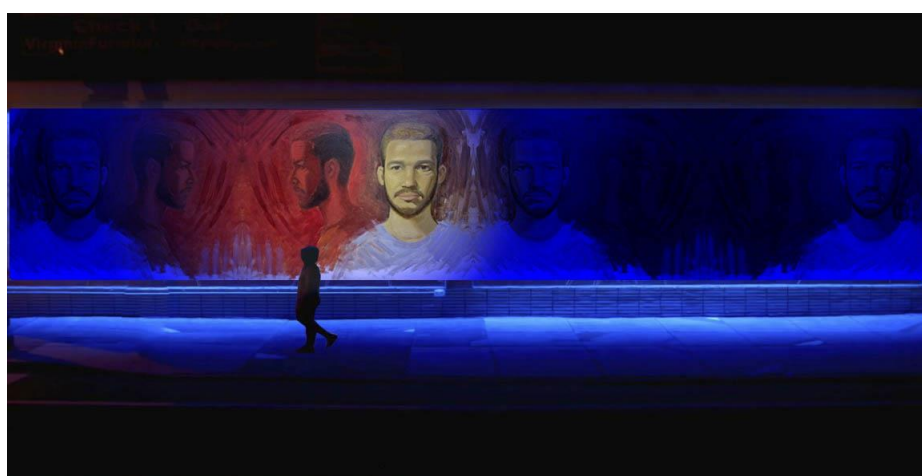


Fig.33.Simulation of the interaction with the viewer position

In this painting the figure lit by the red lighting disappears under the blue lighting.

### Results:

1-The contemporary realism painting can be applied to the interactive mural design. 2-When colors are mixed in subtractive mixing with light we can make shapes morph, appear or disappear with changing the colored lighting on the artwork.

### Conclusion:

Understanding color theories and the effects of colored lighting contributes to add virtual depth in the field of mural painting and let the viewer has a role.

### Recommendations:

- 1-Further studies in the field of modern color theories and color spaces should be undertaken in undergraduate and postgraduate studies.
- 2-Further research based on cross disciplinary collaboration between artists and IT programmers to provide a significant contribution for the interactive murals field.

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<sup>29</sup>The third author of this paper.

<sup>30</sup>The third author of this paper.

<sup>31</sup>Artists Network magazine, May 2010, USA.

<sup>32</sup>The third author of this paper.