

# ColorScheme

Jeremy Rotsztain<sup>1</sup>

<sup>1</sup>Interactive Telecommunications Program, New York University, USA

---

## Abstract

*Composed of colors sampled from Hollywood cinema, ColorScheme is a moving “spectral painting” that reveals how color is used in film to support the themes and mood of the narrative and to subconsciously encourage emotional and physiological responses in the viewer.*

Categories and Subject Descriptors (according to ACM CCS): I.3.3 [Computer Graphics]: Display Algorithms

---

## 1. Introduction to ColorScheme

Composed of colors sampled from Hollywood cinema, *ColorScheme* is a moving “spectral painting” that reveals how color is used in film to support the themes and mood of the narrative and to subconsciously encourage emotional and physiological responses in the viewer. This screen-based video installation runs using a custom authored software application (developed using the C and QuickTime libraries) that removes all form from the original media, leaving only the color.

*ColorScheme* reveals the relationship (or interaction) between colors by visualizing the dominant colors of a scene based on their properties (hue, saturation, luminosity). This process, for example, shows the proportional use of color, the contrast in luminosity, or the variety of hues used to create a composition.

Through the examination of America’s most widely known films from different genres (science fiction, comedy, drama, horror, adventure, etc.), we can harness our knowledge and understanding of a film’s narrative, themes, and meanings to see how more subtle and subconscious aspects of cinema (color, lighting and sound) are utilized to convey those ideas.

By highlighting the subconscious aspects of filmmaking and showing its predictable aesthetic flows and tendencies, *ColorScheme* seeks to change the lens through which we experience popular cinema.

## 2. Background - Color Sampling and Painting with Data

“If you, unknowingly, are able to create masterpieces in color, then un-knowledge is your way. But if you are unable to create masterpieces in color out of your unknowledge, then you ought to look for knowledge.” [Itt61, 7]

“What can I do with sixteen million colors when I am so confused about what to do with three?” [Mun05, 139]

Entering the world of algorithmic image making in 2002, I wanted the graphics that I was generating to maintain a relation to the rich history of modern painting. As a self-taught software programmer with absolutely no practical training in color or knowledge of color theory, I started looking for ways to dynamically extract color schemes from digital images.

### 2.1. Determining Color Schemes

In the fall of 2006, as a first-year student at the Interactive Telecommunication Program at NYU (ITP), I developed the core approach for determining the color scheme of an image for a video installation called *Top 10 Colors* (Figure 1).

In this installation, a computer running a custom-authored software application analyzed a stream of images coming from a live camera and displayed the top 10 colors in a truly formalist fashion - as a series of colored horizontal bars. These bars, whose height was dependent on that color’s relative popularity, slowly morphed over time to reveal new colors at a pace that resembled human breathing.

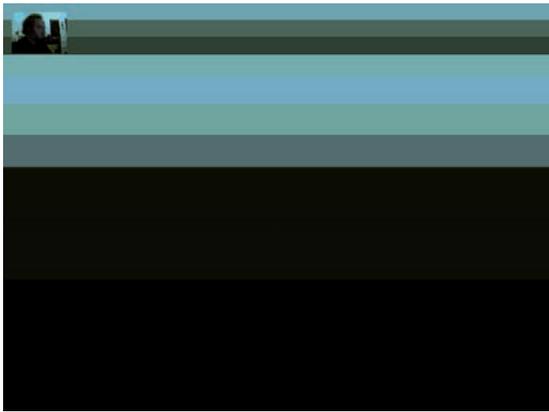


Figure 1: *Top 10 Colors.*



Figure 2: *Dorothy in The Contemplative Brush.*

## 2.2. The Computational Technique

Determining an image's color scheme requires a frame-by-frame, pixel-by-pixel examination of any image media. The computational process involves quantizing the image, minimizing its color resolution from millions of colors (16,777,216 to be precise) to one thousand colors. Image quantization is performed by dividing every pixel's individual red, green and blue values by 25 and then multiplying them by 25.

The software then iterates through the image's pixel buffer, counting the instances of the possible 1000 colors. It then sorts the colors by popularity, handling similar colors (variances of a few RGB values), and, finally, lists the top 10 colors in descending order.

## 2.3. A Spectrum of Applications

Once the color scheme of an artwork has been determined, it can be used for a variety of different applications in computational arts. Immediately after completing *Top 10 Colors*, I created two other projects that used the same framework to explore time-based painterly composition.

*The Contemplative Brush* used this information for determining the order of operations for animating the painting of still images. This customized software application analyzed frames of video from the 1939 film *The Wizard of Oz* and slowly recomposed those frames in a pointillist fashion, using a process that painted more popular colors first (Figure 2). Like *Sunday Afternoon on the Island of Le Grand Jatte*, Georges Seruat's pointillist masterpiece, it would take approximately one year for the software to paint the entirety of the film.

*Painting Portraits* composed portraits of people using samples taken from the MoMA's collection of 20th century modern paintings. The software used information about the color scheme on two levels: (1) to categorize samples of

color extracted from photographs of the paintings and (2) to determine the amount of detail in a portrait. Following the steps of a traditional painter, the software painted larger areas of the portrait's subject before moving on to more detailed sections (Figure 3).

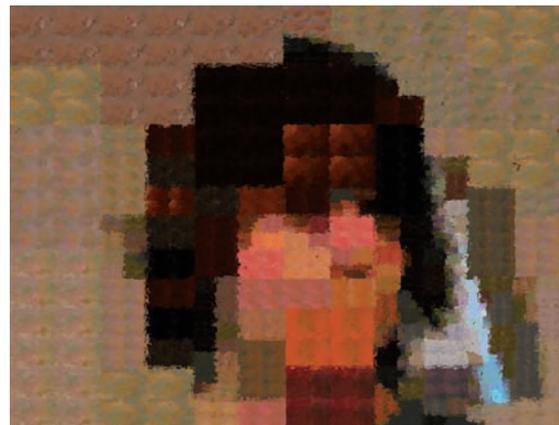


Figure 3: *Painting Portraits.*

## 3. Filmmaking Becomes Painting

There is a growing collection of works that utilize images from Hollywood cinema as raw material for computational graphics. Two notable artists who are working with the use of color in cinema are Jason Salavon and Brendan Dawes.

Jason Salavon has worked with the mean colors of films and music videos to generate high resolution still images and video installations. In *Top 10 Grossing Films of All Time*, Salavon takes Hollywood's most successful films and composes them spatially in a mosaic. He uses the original sounds from the films, which are layered to form a dense sound collage.

In *Cinema Redux*, Brendan Dawes organizes all of the frames of a film across a canvas, emulating the form of a comic book (starting from the top left and moving to the bottom right). In an attempt to “explore the idea of distilling a whole film down to one single image” [Daw04], Dawes reduces each frame to a small number of pixels, a process which allows only the most prominent colors from a frame to stand out in the overall composition. By sampling the film every second and taking a 8 x 6 pixel thumbnail, Dawes is able to create a color DNA of some of his favorite films (*Vertigo*, *Deliverance*, *Serpico*, and *Taxi Driver*).

One interactive web-based application that visualizes the color scheme of well-known modernist paintings (from Kandinsky to Monet) is Dr Woohoo’s *Color Analytics* (<http://www.inthemod.com/inthemod.html>). Published online as a Macromedia Flash applet, users can determine the color scheme of a painting and even select specific colors in order to navigate to other paintings containing those same colors. The program also exports color schemes as XML and text files for users to integrate in their Processing applets and Photoshop compositions.

While these projects effectively show the colors that are utilized in cinematic work, they fail to highlight the relationship between those colors. *ColorScheme* takes that next step: by visualizing the color scheme, it can determine the proportional use of colors, the contrast in luminosity, or the variety of hues used to create a composition.

#### 4. Spectral Painting: Visualizing the Color Scheme

“Our concern is the interaction of color; that is, seeing what happens between colors. We are able to hear a single tone. But we almost never see a single color unconnected and unrelated to other colors. Color present themselves in continuous flux, constantly related to changing neighbors and changing conditions.” [Alb63, 5]

A “spectral painting” performs the dual role of art object and information graphic. Using thousands of varied brush strokes, it expressively visualizes the colors used in a frame of video on a two-dimensional graph, displaying hue on one axis and brightness on another.

Once the software has determined the color scheme of each frame (as described above in section 2.2), it visualizes the dominant colors to display their relationships to one another. The two-dimensional grid displays the hue on the x-axis and the brightness on y-axis (Figure 4). For example, the presence of a bright red color in the original media would be represented by a splotch of that same color in the final visualization.

The size of brush stroke is determined by the relative popularity of that color in the overall image. In the case that there is more red than blue in a given frame of video, the splotch of red that is “painted” on the screen will be larger than the



Figure 4: *ColorScheme* Visualization.

splotch of blue. Hues of varying degrees of saturation are difficult to differentiate, as they are “painted” in the same position on the grid.

Each and every frame of the original movie is analyzed by the software and translated into a painterly digital image. All of the hundreds of thousands of images are then compiled back into a QuickTime movie file and re-connected with the original soundtrack.

#### 4.1. Presentation

The resulting composition can be displayed on a high-resolution LCD display at 1024 x 768 pixels or higher. The work is most effective when accompanied by a second screen, displaying the original work on a small television set. This allows viewers to make a visual connection between *ColorScheme* and the original film or a specific scene.

### 5. Painting Media / Media Painting: Creative & Aesthetic Considerations

#### 5.1. Color Scheme: Cinema & Color Theory

*ColorScheme* explores color theory within the context of filmmaking. In film production, a production designer is typically employed to assist with the determination of a visual treatment. Their plan for the film’s “look and feel” guides the set design, location, costume, make-up, as well as the lighting design.

However, despite the fact that the production designer’s work has an extremely strong impact on the viewer’s visceral and emotional experience of a film, their role is under appreciated in the industry compared to the director, producer or director of photography. As a result, the awareness and recognition of their work is extremely limited in the popular culture.

In his highly influential book on color theory, *The Art of Color*, Bauhaus professor Johannes Itten created a color

wheel for determining relationships between primary colors and secondary colors. The wheel contains 12 different hues that can be used together to create different visual impacts (Figure 5).



**Figure 5:** *Itten's Color Wheel.*

In that same book, Itten also described seven different types of contrast that can be used in the determination a color scheme for painting. They include: contrast of hue, light-dark contrast, cold-warm contrast, complimentary contrast, simultaneous contrast, contrast of saturation, and contrast of extension (relative amounts of color).

The analysis done by *ColorScheme* is ideal for determining which of these color contrasts have been used in the composition of a movie's scene. For example, if the visualization of a given frame reveals a vertical bar of color, then the movie contains a light-dark contrast (different shades or tones of a given color - Figure 6).



**Figure 6:** *Light-Dark Contrast.*

If two colors are along a similar vertical plane but are halfway across the screen from one another horizontally (which relates to 180-degrees on Itten's color wheel), then the movie is utilizing complimentary contrast (Figure 7).



**Figure 7:** *Complimentary Contrast.*

When two complimentary colors are used, the relative size of each color reveals the contrast of extension: the ratio of amount of one color to another (Figure 8).



**Figure 8:** *Contrast Of Extension.*

Unfortunately, because the visualization is only two dimensional (restricted to the x-and y-axes of the screen), it is unable to reveal the contrast of saturation (when one hue is used at a variety of different intensities in a composition).

## 5.2. Color, Meaning and Revisiting the Familiar

"Modern man has come to cherish color and to make it part of his everyday life. Color not only surrounds him but is expressive of his feelings. Everyone from great writers to the man of the street - have sought to convey emotional moods with mere words for color, apparently sure that any reader will comprehend and feel what the writer or speaker intended" [Bir62, 101]

In relating to color using language, we have a very limited number of terms to deal with a subject of such great variety. In English, we have about 12 hues that we regularly use as well as a few adjectives (bright, dark, shiny) that can be used to refer to a greater number of colors. But in no way can these properly terms refer to the millions of colors that are possible on a computer display.

The student of color must be familiar with its use in a variety of fields. Color has a long history in symbolism, starting from the use of color in religious texts and then moving on to stain glass windows and medieval painting. The use of color has been thoroughly studied by psychologists, who widely acknowledge red as having powerful emotional characteristics (anger, love, passion); blue as being calm and subdued. Physiologists have shown that colors have a unique impact on the human respiratory system. Red, for example, increases the heartbeat, while blue calms it.

When examining paintings, art critics and historians frequently obtain a layer of meaning from a painter's creative use of color. They may, for example, write about Picasso's "blue period" in which he painted in a somber blue and blue-green, associating those works with the painter's period of depression. Or they may comment on the stark bright hues used by Kandinsky in his compositions of visual music give the works a tremendous amount of movement.

Popular culture film critics, schooled more in narrative and film history than color theory, rarely examine a film's use of color in great detail, choosing instead to follow the tastes of their mainstream audiences and write about plot development. Hitchcock's *Vertigo* is one obvious exception. *ColorScheme*, however, provides its audience with a framework to draw connections between a film's narrative (as well as its underlying themes) and its symbolic, psychological, and physiological uses of color.

### 5.3. On Materiality: Sampling and the Texture of Painting

In viewing a painting at a museum or gallery, some people experience the work from multiple distances. First, they stand away from the painting in order to appreciate the composition as a whole. Then they move extremely close to examine the work in detail. This interaction with the work gives them the opportunity to see the painterly style and skill of the artist through looking at thousands of brush strokes.

The viewing of Georges Seurat's pointillist paintings provides an excellent example. When seen from a distance, we can experience the optical mixing process, where the eye mixes the colors of a series of brush strokes to form a single color. From up close, we can examine and make sense of his complex dotted brush technique and use of complimentary colors to achieve this effect.

Contemporary Brazilian-American artist Vik Muniz encourages this interplay in his photographs. He arranges thousands of small objects to form portraits and landscapes and then photographs them in large format. In *Pictures of Diamonds*, he arranged thousands of diamonds to compose portraits of celebrities, including Marlene Dietrich and Betty Davis. In *Pictures of Pigment*, he arranged raw colored pigment (in the form of a powder) to compose works in the style of Monet and Cezanne. Viewers of Muniz's work play in a liminal space, moving back and forth to see the big picture, experience the materiality of the medium, and explore the narrative created through the selection and arrangement of the objects.

In using textures sampled from the original film media, an additional layer of meaning and experience is added to *ColorScheme*. When a texture containing red is visualized (instead of using the pure color on its own), it offers the viewer the ability to experience the "material" of the medium, the pixels. Using this process, I am also able to achieve stylistic aspects of painting not possible using digital painting tools like Photoshop.

Unfortunately, when working with consumer digital media, the amount of resolution that we have available to us is limited. HD projectors and wide-screen televisions are giving visual artists who work with technology a larger canvas (greater than the 720 by 240 pixels on traditional DVDs). If shown on a high-resolution display, *ColorScheme* can operate at larger resolutions than NTSC DVD.

### 5.4. Postproduction: The Remix

"By refilming a movie shot by shot, we represent something other than was dealt with in the original work. We show the time that has passed, but above all we manifest a capacity to evolve among signs, to inhabit them." [Bou02, 53]

*ColorScheme* re-appropriates cinema, using its scenes and frames as building materials in an effort to define a new awareness for the viewer in their film-viewing experiences. Projects like *ColorScheme* and *Top 10 Grossing Films of All Time* fit into a category of works loosely defined by French Curator Nicolas Bourriaud as "postproduction."

Like the remix, postproduction works are new iterations of completed works. It involves what the Situationists called "détournement" - the re-framing a work for a means that is different from the original. Bourriaud writes "postproduction artists invent new uses for works, including audio or visual forms of the past, within their own constructions. But they also re-edit historical or ideological narratives, inserting the elements that compose them into alternative scenarios." [Bou02, 45]

In remixing Hollywood cinema, I would like to discourage audiences from accepting cinema at face value, instead encouraging them to see beyond narrative storytelling and to

identify with works that deface mainstream media and disrupt its flows.

Simultaneously, this model could be used by other artists working with digital color information in visual composition. Other works using the same computational process could use color information to manipulate and reverse intended messages or create entirely new abstract compositions.

### 5.5. The Sound of Color

*ColorScheme* maintains a narrative through the inclusion and synchronization of the original soundtrack. The use of the soundtrack is critical in order to give the viewer a connection to the formalist visual composition. It offers them the opportunity to recognize familiar scenes or to follow the dialog of the film and establish a relationship between the story and the use of color.

## 6. Future Iterations of ColorScheme

The next step for *ColorScheme* involves the close examination of popular genres of filmmaking to look for patterns in color composition and meaning in narrative storytelling. Instead of using movies in their entirety, I will collect cliché scenes from films of similar genres and apply this same process. So far, I have outlined three possible constructions: *69 Love Scenes*, *2001 Depictions of the Future*, and *1945 War Scenes*.

*69 Love Scenes*, which I hope to realize as my thesis project at ITP in the spring of 2008, will explore the use of colors in scenes taken from romance films (*Pretty Woman*), romantic comedies (*Notting Hill*), and perhaps even pornography. No doubt the results will reveal a lot of skin, but possibly also some uplifting and loving tones of color.

*2001 Depictions of the Future* will be composed of strictly scenes from science fictional films containing futuristic imagery. This work may contain buildings from *Blade Runner*, landscapes from *Logan's Run*, transportation from *Star Wars*, and fashion design from *Planet of the Apes* or *RoboCop*. I expect to see a large collection of grays, and a dominance of low-saturated colors.

*1945 War Scenes* will examine battle scenes compiled from the last 50 years of war movies, including World War Two films (*The Longest Day*), Vietnam films (*Platoon*, *Heart of Darkness*), cold war films (*the Hunt for Red October*), commando films (*The Guns of Navarone*), films about the gulf wars (*Jarhead*), and also military science fiction films (*Starship Troopers*). These scenes will likely have an incredible number of dark colors.

Through the examination of a significant number of clips culled from specific genres of filmmaking, I expect to find recurring patterns between color composition and narrative storytelling.

## References

- [Alb63] ALBERS J.: *Interaction of Color*, 5th ed. Yale University Press, New Haven, Connecticut, 1963.
- [Bir62] BIRREN F.: *Color in Your World*, 5th ed. Collier Books, New York, New York, 1962.
- [Bou02] BOURRRIAUD N.: *Postproduction*, 2nd ed. Lukas & Sternberg, New York, New York, 2002.
- [Daw04] DAWES B.: *Cinema redux*. <http://www.brendandawes.com/sketches/redux/>, 2004.
- [Itt61] ITTEN J.: *The Art of Color*, 5th ed. Van Nostrand Rheinhold Company, New York, New York, 1961.
- [Mun05] MUNIZ V.: *Reflex: A Vik Muniz Primer*, 1st ed. Aperurte Books, New York, New York, 2005.