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Summer 2016

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Abstract

This paper evaluates current practices in digital imaging of works of art and examines whether those practices result in colors that are as accurate as possible in relation to the original intention of the work. Currently, a standard color temperature is applied to digital images of works of art in order to facilitate consistent results among all users and mediums. This standard may not render the best color for individual works when compared to one that more accurately represents the conditions present when the work was created. This paper proposes that a set of color temperatures be defined that can be applied to general categories of art which will result in a more correct representation of the colors intended by the artist, when those intentions can be discovered or inferred. Determining the relevant data about the artist, materials used and conditions present when the work was created that affect the color temperature applied to the work should result in a digital image that can be considered a definitive image for archival and scholarly use but not necessarily a replacement for the current standard images used for web and print. In addition to the digital image, all documentation on how the illumination was determined and how the image was captured and manipulated should be saved with the image.
Table of Contents

I. INTRODUCTION .................................................................................................................. 4
II. PHOTOGRAPHING WORKS OF ART .................................................................................. 5
   A. CHALLENGES WITH IMAGING WORKS OF ART .......................................................... 7
III. THE PROBLEM WITH STANDARD ILLUMINATION ....................................................... 8
IV. COLOR IN DIGITAL IMAGING OF WORKS OF ART ....................................................... 9
V. CURRENT ILLUMINATION STANDARDS ......................................................................... 10
   A. COLOR TEMPERATURE ................................................................................................ 11
   B. CIE ILLUMINANTS ....................................................................................................... 12
   C. THE GOAL OF AN ARCHIVAL IMAGE ....................................................................... 13
VI. WHAT WE EXPECT TO SEE .......................................................................................... 14
VII. TYPES OF IMAGING ..................................................................................................... 15
VIII. DETERMINING AND CHANGING THE ILLUMINANT .................................................. 16
IX. THE STUDY ..................................................................................................................... 17
   A. SPECTRAL IMAGES UNDER DIFFERENT ILLUMINANTS ...................................... 19
   B. D65 IMAGES UNDER DIFFERENT ILLUMINANTS .................................................... 20
      1. Woman Holding a Balance ..................................................................................... 20
      2. Madonna and Child Enthroned ............................................................................. 22
X. APPLYING THIS METHOD TO OTHER WORKS ............................................................. 24
XI. DOCUMENTATION .......................................................................................................... 26
XII. CONCLUSION .................................................................................................................. 27
XIII. APPENDIX: ANALYTICAL TECHNIQUES .................................................................. 29
   A. SPECTRAL IMAGE ...................................................................................................... 29
   B. D65 IMAGES ............................................................................................................. 29
XIV. REFERENCES .................................................................................................................. 29
Determining Color Temperatures for Archival Digital Images of Works of Art

I. Introduction

A digitized image is a surrogate for a work of art in that it stands as representation for the work in other types of media. Digitized images of works of art are used for many purposes including research, study, marketing and enjoyment. Many digital images of works of art can be found on the Internet. However, they may differ greatly in quality and accuracy. Museums create digital images for the above purposes as well as to provide accurate images that can be relied upon for scholarly use. Currently, digital images are created with a standard of illumination that does not take into account the illumination that is best for the individual work and may not render the optimal colors for each painting.

A digital image should be created in such a way that it can be considered an archival record of the work at a certain point in time. Not created for a certain output or preference, it should have quantifiable color results based on research and established scientific methods. In order to achieve this, it is essential to consider the way in which the colors in the digital image are created and manipulated and how well the resulting image represents the colors that were intended by the artist as far as can be known or inferred by the relevant facts regarding each individual work or artist. Roy Berns, of the Rochester Institute of Technology, points out that digital images should do more [than just create an image]; they should facilitate scientific documentation and study of works of art” (Berns, 2001). This entails thinking about questions such as where, when and by whom the work
was created, the materials that were used and under what lighting conditions were the works created and/or intended to be displayed.

An example of illumination playing an integral part in the appearance and experience of art – and which is not re-created in today’s museums and digital images, is Byzantine icons. In *The Sensual Icon*, Rebecca Corrie and Bissera Pentcheva describe the experience of looking at a Byzantine icon in its intended church setting with moving sunrays, flickering candlelight, and even the atmosphere of breath playing on the mixed surfaces of the icon and creating an experience that uses several senses creating *poikilia* or ‘phenomenal effects’ when viewing the works. They add,” Unfortunately, the electric spotlighting and clinical setting of the modern museum have destroyed the medieval *poikilia*. Similarly, photography has tried to capture an "objective" replica of the icon” (Corrie et al., 2012). They propose video as a way to create the truest digital representation of the icon. While their proposition is more about capturing the experience of viewing the art, not just the colors, it does illustrate the idea of attempting to capture a digital image that is as true to the original intent of the work as we are able to capture with digital means.

Creating this “as true as possible” digital image requires study and technical expertise that sets it apart from other digital images and embeds its value for long-term preservation as an archival image.

**II. Photographing Works of Art**

Works of art and historical sites have been photographed since the invention of practical photography in 1839. According to Allan Kohl in *Revisioning Art History: How a century of change in imaging technologies helped to shape a discipline* (Kohl, 2012),
the advent of photographing works of art is what enabled Art History to become the discipline of study it is today with the ability to use images for study and comparison in books and classrooms. Previously, the study of art would have required travel and relied on sketches, engravings or copies of works. Obviously, technology has come a long way and we are fortunate to have access to many high-quality digital images online, which we can use for detailed viewing. Major museums and Google Art Project are making great investments in creating extremely high-resolution images to offer scholars and patrons across the world virtual access to museums and works of art from wherever they are. Using a digital image of a work of art from a trusted source is a great resource in the study and enjoyment of art.

Using an image from a trusted source is an important distinction. Consistent and accurate color results are only as good as the source from which they were obtained. Poorly made digital images abound on the Internet and can be a source of confusion. This fact has prompted museums to provide high-quality down-loadable images from their own websites or by request, so there will always be access to a definitive image. In *The Problem of the Yellow Milkmaid: A Business Model Perspective on Open Metadata*, (Verwayen et al., 2011), the authors relate a case of a museum (Rijksmuseum) finding over 10,000 poor reproductions of one of its Vermeer works on the internet with drastically different color results among them. This caused patrons of the museum to question if the museum’s own publications were correct. The museum decided to allow open access to its metadata so that the image could be found using the cultural heritage aggregator Europeana, the European counterpart to the U.S.’s Digital Public Library of America (DPLA). The paper also points out that the public prefers the trusted source to
anonymous sources, which means they trust that the owner museum is providing the most accurate representation of the work (p. 15).

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A. Challenges with imaging works of art

Creating a high-quality digital image of a work of art is not an easy task. It comes with many considerations such as the effects of moving the art for imaging, the difficulty of imaging the work in situ, the effects of light and heat on the work during imaging and the costs in labor, expense and impact on the work of art. Not to mention the expertise required to capture the image, process, manipulate, store and manage it. These challenges mean that creating a high quality digital image may happen once or at most very infrequently.

Due to the possible negative effects of imaging on works, conservation is the main consideration when creating a digital image. Conservators have determined standard allowable types of illuminants that can be used while imaging works of art.
Therefore, the illumination used at the time of the image capture has a narrow allowable range and frequency. Working within these conservation parameters, photographers and imaging scientists use a standard illumination in order to assure the most widely reproducible results over all mediums.

III. The problem with standard illumination

Using a standard illumination for all digital images helps to ensure consistent results for all of the afore-mentioned uses. However, all works of art were not created under the standard illumination that is currently used for digital images of works of art. Therefore, some information is lost in the actual colors that are represented in the digital image. Being able to identify a digital image as an archival record includes considering the colors that are being represented. Since the type of light that illuminates the work helps create the color, it cannot be possible that all digital images of works of art are representing the correct colors all under the same illumination.

An interesting example of trying to ‘recreate’ the original colors in a work of art is Mark Rothko’s Harvard murals. These murals were created to hang in Harvard’s Holyoke Center where they were displayed from their installation in 1964 to 1979 when they were put in dark storage. The room where the murals were displayed had lots of natural, unfiltered light. That UV light, coupled with the materials Rothko used, caused the colors of the paintings to change dramatically. In fact, the paintings were considered to be ruined. Due to the materials that were used, conventional conservation techniques were not able to restore the paintings so Harvard developed a system that projects light, pixel by pixel, onto the canvases to put the color back. When the paintings were on exhibit, watching them as they were ‘turned on’ was an event of its own.
Harvard determined the colors to be projected onto the faded canvasses by using Ektachrome transparencies (which also had to be restored) that were used to photograph the paintings at the time of installation in 1964 (Stenger et al., 2016). They also had access to a similar work that was not displayed, to which they could compare colors, and they performed many tests to understand the materials and methods Rothko used. Their illumination choices were also influenced by Rothko’s own preferences for how his works should be illuminated. Rothko preferred his works to be viewed in low light because too much light destroyed their inherent luminance and distorted their meaning. Rothko felt that the paintings should be viewed “in the same light in which they had been painted” (Stenger et al., 2016). Rothko was referring to in-person viewing but, it would not be too much of a stretch to assume that he would want the same considerations of illumination taken with digital images of his works.

The Harvard mural project is an example of the types of research and technical expertise that can be brought to bear on decisions about the appropriate illuminant to use in rendering archival digital images of works of art. It reinforces the point that a photographic image can be an extremely important resource for conservation and restoration in the future and should represent the most accurate colors possible. It also shows how experts in different fields should have input in the process of determining the color rendering.

IV. Color in digital imaging of works of art

Capturing and calibrating colors in digital photography, including those specifically relating to cultural heritage, is not a new subject. There are many studies and in fact, entire schools, that are devoted to the science of color. One that has been utilized
extensively for this paper and is a leader in the field is the Rochester Institute of Technology (RIT).

Digital photography is a complicated science with an immense variety of options in capturing, manipulating and displaying images. Because of the amount of variability, standards are followed by everyone in the digital imaging chain including photographers, color scientists, printers, and conservationists so that everyone is on a level playing field and will be able to reproduce the same results over different mediums. In other words, because of the use of standards in illumination, we can reasonably expect to see consistent colors whether looking at a digital or print image.

The type of illumination used during the digital imaging of a work of art is important because the way light shines on an object is what helps create the color. For example, if you look at a wall that is partly in shadow you will see that there are two different colors: where the shadow is hitting the wall and where the light is hitting the wall. We don’t think of it as two different colors because we know the wall is painted all the same color. We just see light and shadow. Now, take a picture of the wall -- the camera and computer will interpret the two areas as two separate and distinct colors. Say you open your image in Photoshop and you want to make the wall all one color. Which color is the true color? In real life, they are both true -- the two areas are just affected differently by the light shining on them.

V. Current illumination standards

The current standard of illumination used when making a digital image of works of art conforms to print industry standards. Kenneth Fleisher, Color Scientist at the National Gallery of Art, points out that the print industry standard illumination is D50
and, “the museum community has generally adopted this workflow so that the color of printed reproductions can be reliably communicated to the printer.” (Fleisher, 2008) Generally, D50 is used for print imaging and D65 is used for web-based images (Berns, 2001) but there is little practical difference between the two.

The standard of illumination, or color temperature, of D50 corresponds to daylight (D) at a color temperature of 5003K. Roy Berns, of RIT, points out that in his experience the CIE illuminant D65 and the 1964 standard observer “corresponds to viewing objects in a natural-daylight lit studio with north-facing windows or typical conservation laboratories” and, “this combination leads to the best correlation between numerical and visual color quality” (Berns, 2001). While northern light in a studio is a standard preference of artists, the actual color temperature in an artist’s studio is variable due to what illumination they had available, their artistic preferences and where they were located geographically.

**a. Color temperature**

Daylight is a spectrum of colors that can be filtered or scattered by atmospheric conditions such as moisture and gasses in the air and influenced by reflections of nearby objects. For example, water can reflect the sky and appear blue or reflect vegetation and appear green. Similarly, artificial lighting comes in different colors depending on the type of bulb and the gasses and elements it is composed of. It is sufficient for this paper to know there are differences in color temperature in anthropogenic sources of light such as candles and electric lighting and in daylight, which is why the sky looks predominately blue but when affected by moisture and gasses in the air can appear white or gray. For
reference, the color temperature of the sun outside of the atmosphere is 5577K.

\textit{b. CIE illuminants}
CIE illuminants D50, D65 and the 1964 standard observer mentioned above refer to CIELAB -- a color standard that was created by the International Commission on Illumination (CIE) and contains all perceivable colors in a three-dimensional model based on human vision. It includes common color schemas such as RGB and CMYK and goes beyond them. CIELAB is used to convert from one color representation system to another and is device independent meaning that it represents true colors, not colors dependent on software or a display screen rendering. CIELAB takes into account the three required visual factors: the spectral curve of the object, the illuminant and the observer (a human or camera). The D65 illuminant is an attempt to correspond to average daylight with somewhat clear blue skies. It is recommended by the CIE to be “used in all colorimetric calculations requiring representative daylight, unless there are specific reasons for using a different illuminant” (CIE, 2016). The CIE goes on to say: “Variations in the relative spectral power distribution of daylight are known to occur, particularly in the ultraviolet spectral region, as a function of season, time of day, and geographic location. However, CIE standard illuminant D65 should be used pending the availability of additional information on these variations.”

c. **The goal of an archival image**

The most accurate color rendering should be obtained without the current constraints of standard illumination from the print industry and conservationists. Roy S.
Berns, a leader in the field of color science, says: “The goal [of creating a digital image] is to have the capability to estimate quantitative information about the object, not create a visually equivalent representation for a defined output device such as a display or printed document” (Berns, 2001). The archival digital image should be created using an illuminant that has been determined to be as similar as possible to the color temperature that the artist worked under or preferred. The resulting image may not show much difference from the standard image or it could be drastically different. In addition, it may not be as pleasing to look at or be what we expect to see.

VI. What we expect to see

The goal of this paper is to show that there is a need to have a digital image of works of art that is quantifiable or justifiable. It should not be created for a certain use, output, expectation or preference but rather, it should be created and supported by the research, scientific evidence and technical processes that influenced each decision in the creation process. Therefore, the fact that the image should be quantifiable makes it irrelevant how people feel about viewing it. However, unless the change was exceptionally drastic, most people probably wouldn’t notice. A 2006 study by Boust and Ezrati (Boust et al., 2006) showed that changing the illuminants of the paintings viewed by study participants did not change their preferences for certain works and did not change the perceived meaning or experience of viewing the work. Their eyes were adapting to the new illumination (chromatic adaptation) and even their memory may have been playing a part in adapting the different illuminations to what they expected to see.
VII. Types of imaging

Due to the nature of color and light, creating a digital image is a more subjective process than one would think. Even some colors in the best digital photographs will likely need to be manually adjusted to match what the imaging specialist sees because some colors do not render digitally as they are seen by the human eye. Professionals make sure that all steps in the imaging process are done under the same illumination. A work of art digitally captured under D50 lighting will be compared to the original under D50 lighting to make the correct color adjustments.

The two types of imaging most used by museums today are digital and spectral. Digital cameras depend on a light source to “see” the colors in an RGB color space. A spectral image is device independent and gives a reading of the reflectance of the pigments and therefore is not dependent on a certain light source. Spectral imaging is currently an expensive undertaking and is consequently used on relatively few works of art.

The most common imaging equipment used by museums is the digital camera. Google Art Project uses a Giga-pixel camera on some works that contains 7 billion pixels, which is about 1000 times more detailed than an average camera and is like being able to look through a microscope on your computer screen (Google Art Project, 2016). Images are taken in sections with a moving camera and later the sections are stitched together digitally. Similarly, the National Gallery of Art has a system for taking high-resolution images with a movable easel and stationary camera. Because these camera systems are not spectral they are dependent on the illuminant used during the imaging process for the color outcome.
VIII. Determining and changing the illuminant

Clues to where an artist painted and what illumination he or she used can be found in contemporary photographs, writings, paintings and the artist’s own work. In *The Art of Painting* by Vermeer (1666) we see the artist in his studio. While very similar in setup to the scenes in his other paintings, this view takes us back further in the room and shows us the scene from behind the artist. It could be inferred that this is similar to Vermeer’s own studio, if not the studio and artist himself. The artist is clearly using daylight to illuminate the scene. A chandelier hangs above but it is not lit.

A photograph of Mark Rothko in his studio shows an abundance of windows and natural light and, as mentioned previously, we know some of his opinions on how his work should be lit even if he not did specify a certain color temperature.

Northern daylight has been the most common type of studio lighting and in the absence of other information to the contrary it is assumed that this applies to most works. The variability in illumination is in the color temperature of the daylight that comes into the studio. Even when using artificial lighting, artists are usually careful to use the most neutral color temperature bulbs, but that is a matter for study in the case of individual artists.
Even when the exact illuminant is known, it would not be practical or permissible to change the illuminant of every work of art during the image capture. No museum is going to turn out the lights, light candles and hold them close to a painting while an image is being made. Therefore, the change of illuminant must be accomplished after the standard image has been made using computer modeling.

IX. The study

For a test study, we changed the illuminants on the two types of images: spectral and colorimetric. To show effects of different illuminants on spectral images, we are using an image created by RIT. RIT created a set of paintings to represent Old Master and Modern paint palettes. The image C_1_3_3 was chosen due to its similarity to
Vermeer’s palette specifically the colors ultramarine blue, carbon (charcoal) black, red oxide (earth), yellow ochre (earth) and raw umber (Abed, 2014). The two digital images are from the National Gallery of Art.

The two works of art chosen to represent the digital images are each from a different time period and geographic location: Woman Holding a Balance by Vermeer from 1664, Delft and Enthroned Madonna and Child by Byzantine from 1250, Constantinople. They were taken with direct digital capture under D65 illumination. In order to digitally apply a different illuminant, the reflectance is removed (see Appendix). The color that is left is mapped to CIE space and a new illuminant can be applied. Since the original digital capture was made under D65 lighting, the colors left after the reflectance is removed are still colors created with D65 lighting. Therefore, while a different illuminant can be applied, it is still being applied to colors captured under D65 lighting and may still be slightly skewed. Translation between color spaces using three primary colors (RGB) is not exact.

The ideal test for different illumination should be done using spectral images where more precise color translation can be obtained. In Technical Guidelines for Digitizing Archival Materials for Electronic Access, the National Archives and Records Administration (NARA) states: “If multi-spectral imaging was feasible from a technical perspective, it would be preferable for preservation digitization.” This unfeasibility refers to the fact that spectral imaging is expensive and time-consuming and most organizations don’t have the computer software or expertise to manage spectral images. There is also a greater amount of data generated by a spectral image so there are increased storage costs.
a. Spectral images under different illuminants

Figure 5: Original spectral image from RIT

Figure 6: Spectral image with Daylight (5003K)
b. **D65 images under different illuminants**

1. **Woman Holding a Balance, Vermeer**

   In order to apply a different illuminant to the Vermeer work we can consider the known conditions present when the work was created. For example, we know the following:
   
   - The work *Woman Holding a Balance* was painted by Vermeer in Delft, the Netherlands in 1664.
   - Vermeer worked in a studio with daylight as the light source.
• The geographic coordinates of Delft are 52.0116° N, 4.3571° E
• Delft is classified in the Köppen-Geiger Climate Classification system as Cfb which equals warm temperate, fully humid, warm summer
• 1664 corresponds to the Maunder Minimum – a period of time during the Little Ice Age where sunspot activity was extremely low and therefore, solar radiation was low.
• The climate in Delft today is generally considered hazy and cloudy with marine aerosols and average cool temperature of 36 d. f – 66 d. f., frequent rainfall, clouds, and fog.

While all of this detail may not be necessary, it is an example of the kinds of information that can be found that could affect the daylight color temperature that a particular artist may have worked under. Regarding Vermeer working in Delft, we can say that Delft is a location with a prevalence of overcast, cloudy days, high moisture, marine aerosols and low radiation, all of which would produce a higher color temperature resulting in more blue tones and less reds.

If we apply a color temperature that corresponds to an overcast, hazy atmosphere to the Vermeer work of 8000K it changes the color representation slightly. The work now shows more blue tones while the red/orange tones are less bright.
Another approach to applying different illuminants is to determine the lighting temperature for where a work was intended to be displayed. An example of this would be a medieval icon from the Byzantine period that we know was created for a church. This requires less knowledge about the local climate and more about the specific intended location. Works that would use this method are works that were created as part of the architecture of a building such as icons and frescoes and any known specific interior location.

The Byzantine icon was created for the Orthodox Church, which has specific lighting requirements for the church and the icons. The church tends to be dimly lit overall to encourage a calm, meditative atmosphere. Historically lit only with candles or oil lamps and strategically placed windows for some natural light. Today some Orthodox churches use electric lighting but the same effects are designed. The lighting emphasis in
the church is on the faces of the icons and this is done beautifully with candles or oil lamps. Bright universal light would not allow the gentle emphasis on the faces of the saints and would destroy the meditative atmosphere of the church. (Hart, 2015)

![Figure 1: Example of is in Valaam Monastery](image)

The figure below is *Madonna and Child Enthroned* from the 13th century illuminated with D65. The figure next to it is illuminated with the color temperature of candlelight (2000K). Note: this work contains gold leaf, which complicates the imaging process. It is shown here as an example of a work known to have been created for display under candlelight.

Keep in mind that when a work of art is imaged at the National Gallery of Art, the image is compared to the original under the same illumination and changes to the digital image are made by the photographer or scientist *while looking at the work*. This is because not all colors translate digitally due to the properties of the pigments and materials such as gold leaf. This would still be the case with changing to another illuminant although, you wouldn't hold candles up this work to compare it, you could
compare it to samples of the same pigments viewed under candlelight to do a visual comparison. Getting the correct colors under a different illumination will still require the same time-consuming individual scrutiny.

Figure 12: Madonna and Child Enthroned D65

Figure 13: Madonna and Child Enthroned D20

X. Applying this method to other works

The above examples show that differences in color temperature affect the colors in a digital image of a work of art enough to change them, sometimes significantly. The greatest differences in color are in works created at either the low or high end of the color temperature scale, which would apply to works created or displayed in more unusual
Determining Color Temperatures for Archival

conditions such as candle or torchlight and bright daylight. However, as seen in the Vermeer work above, the changes from D65 to D80 were more subtle but still noticeable.

In order to apply this method to other works it will be necessary to create a color temperature chart covering broad categories of works. The chart would need to list the different lighting situations that artists have worked under and their corresponding color temperature. Variations in color temperature occur but general levels have been established and will be used in this chart. The following items are by no means a comprehensive listing of possible light sources but just use the examples from this paper.

<table>
<thead>
<tr>
<th>Setting/Location</th>
<th>Example</th>
<th>Illuminant Type</th>
<th>Color Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Church</td>
<td>Byzantine icon</td>
<td>Candlelight</td>
<td>1800-2000K</td>
</tr>
<tr>
<td>Northern lit studio or plein air works</td>
<td>Vermeer, Monet</td>
<td>Daylight</td>
<td>5000-10000K</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Refer to geo-location</td>
</tr>
<tr>
<td>Artist preference</td>
<td>Rothko</td>
<td>‘Low light’</td>
<td>unknown</td>
</tr>
</tbody>
</table>

Figure 14: Color temperature chart based on type of illumination

For works of art that fall in the daylight category, a sub-chart for geographic location could be made based on the general color temperature of certain geographic areas. The primary climate effect that would determine color temperature for a certain area would be aerosols in the atmosphere. Aerosols in the atmosphere change but general characteristics can be seen in areas that are: humid, rainy, dry, sandy or located by the sea (marine). Aerosols also include the amounts of smoke and pollution.

Color temperature could be further specified by time period. One major time period classification could be pre-and post-industrial revolution. Other factors that could affect time period are events such as volcanic or sunspot activity. These calculations are difficult and may not significantly affect the color temperature results especially if there
is not a long-term change in the atmosphere due to the event. Karen Harpp, in a Scientific American article, suggests that major volcanic eruptions can alter the atmosphere significantly over large parts of the globe and for many years. She relates a story of Benjamin Franklin observing that in 1783 there was “a constant fog over all Europe, and [a] great part of North America” (Harpp, 2005), which was caused by volcanic activity.

XI. Documentation

The documentation that accompanies the archival digital image is critical to future generations being able to gain quantifiable information about the colors of the work of art at the point in time that the digital image was created. Much information is saved in the camera data but additional post-capture color changes should be described so that they can be repeated or removed. In addition to the technical information, the factors that determined the choice of illumination should be recorded. This may require item level metadata or a metadata reference to where the additional information can be found.

Normally, the digital image goes into an institution’s Digital Asset Management System (DAMS) and from there, derivative images are made and access is given throughout the museum to those who need it. If the archival image is not going to replace the standard illumination image, it should be labeled with a file name or metadata that refers to its status as an outlier and not part of the normal derivative chain of images that will be used for the traditional purposes mentioned in this paper. Proper preservation practices should be followed to ensure that this digital image will be available for future generations. The AIC Guide to Digital Photography and Conservation Documentation (AIC, 2008) lists important things to consider in a long-term preservation plan for the digital image. A few of them are:
Color temperature of illuminants affects the colors rendered in digital images of works of art. Using the standard print industry color temperature for all digital images does not accurately reflect the differences in illumination that pertain to individual works of art. In order to create an image that can be an archival record that most accurately renders the original colors, various disciplines need to come together to determine appropriate color temperatures. The difference in colors when another color temperature is applied may be dramatic or hardly noticeable. Further, the image may not be appropriate for necessary uses such as web and print. Therefore, it may not be appropriate to replace the standard illumination image with the archival image for those uses.

The archival digital image should be created by considering all the knowledge available about the artist, materials, location and time period relating to the work. Ideally, it would be created from a spectral image. An imaging specialist can bring all of this knowledge together to apply a color temperature to the work that gives us another interpretation based on known facts.

All of the data used to make the image should be documented with the image as well as the factors that contributed to the determination of the illuminant. The long-term preservation of the image depends on following good digital curation practices for the lifetime of the image.
Works of art are individual and unique therefore, the digital images that are used to represent them should consider their unique qualities in illumination in order to create a truly archival digital image.
XIII. Appendix: Analytical Techniques

A. Spectral image
The spectral image was downloaded directly from the RIT site: https://www.rit.edu/cos/colorscience/mellon/im_spectralDatabase.php

The image was manipulated in Matlab to add different illuminants.

B. D65 images

The D65 images were downloaded directly from the National Gallery of Art image site NGA Images: https://images.nga.gov/

These images were manipulated in Matlab to adjust the color balance to a new illuminant.

XIV. References


