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# Enhancing Museum Exhibits: The Impact of Lighting Design on Artifact Display

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This paper examines the importance of lighting in museums and its application in enhancing artifact display and visitor experience. Lighting is a very important factor when it comes to making a museum aesthetically appealing, because it must be used to draw attention to specific attributes or details on the pieces and to convey to the viewers the historical value of the exhibit. By carefully considering color temperature, intensity of light as well as direction of light in relation to the artifacts, museum curators and designers can effectively manage the illumination of artifacts and create an interesting and a memorable exhibit area. Through qualitative research methods which includes case studies and existing literatures, the study explores various lighting techniques and their effects on visitor experience, this study highlights the crucial role lighting plays in illuminating the past and enhancing the display of historical artifacts. The findings reveal the critical role of lighting design in the interpretation of artworks and in enhancement of visitor experience.

**Keywords:** lighting design, museum setting, artifact display, visitor experience, interpretative context

## INTRODUCTION

A museum is a non-profit, permanent institution in the service of society that researches, collects, conserves, interprets and exhibits tangible and intangible heritage (ICOM, 2007). Museums are also great depositories of our history and traditions as they display a variety of objects that are of historical significance. Still, the effectiveness of delivering historical narratives isn't solely in the quality of vestiges but in the manner of their display. Museum lighting design is the purpose, conception, and expression of spatial composition through natural or artificial light. It is a reflective process that incorporates the sensitivity of the lighting designer and the capabilities of lighting technology (Gobbato, 2023). Lighting design is integral to creating engaging museum environments that facilitate learning and emotional connection with artifacts (Falk, 2009). Lighting creates visual experiences in any exhibition, it modulates and isolates the visual landscape, enhances the impact of a presentation and is vital for spatial impression and enjoyment of art (Licht, 2002).

When it comes to museum exhibitions, the presentation of artifacts is not only an act of making the objects from the past available for viewing but also about how to engage visitors and provide them with quality experience (Smith & Jones, 2018). Providing a top-notch experience is a vital component in displaying artifacts. In order to give guests a meaningful and interesting experience, a careful presentation that goes beyond simple visibility is

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required. Pivotal to this effort is the role of lighting design, which constitutes an important element of designing to make the visibility, the aesthetics, and the interpretative stories of displayed artifacts (Brown, 2016).

Lighting design also plays a key role in enhancing the visual appeal of artifacts, drawing attention to their intricate details and historical significance (National Park Service, 2019). The right lighting can add drama and atmosphere while bringing out the textures and details of the artifacts. Poor lighting on the other hand can make it difficult to see details, produce glare and ruin the viewing experience altogether.

Proper lighting design not only enhances visibility but also contributes to the preservation of artifacts by minimizing light-induced degradation (García-García et al., 2017). Choi and Kim (2017) emphasized the use of color temperature variation in lighting design to evoke different moods and enhance thematic narratives within museum exhibitions. Museum designers and curators can create visually striking displays that emphasize the beauty and significance of the artifacts on display by carefully considering elements like color temperature, intensity and light direction.

Lighting design in museums is no longer limited to mere illumination; it has become an art form in itself, capable of transforming the perception of artworks and creating a narrative within the exhibition space (Bartenbach, 2016). The strategic use of lighting can highlight specific details, evoke emotions, and guide the visitor's gaze, ultimately shaping their interpretation of the artwork (Bartenbach, 2016; Zeisel, 2017). A well-designed lighting scene stimulates the senses on an aesthetic, emotional and cognitive level while also interacting with visitor's construction of meaning on an artistic and cognitive level.

The lighting design of an exhibition space has a great impact on visual and colour perception and different lighting arrangements can create very different visual impression of artworks and, if not carefully designed, compromise the enjoyment of the viewers (Leccese F, Salvadori G, Feltrin, Morozzi R, Nieri P. , 2018). The dual function of lighting in both presentation and conservation underscores its central position in the modern museums practices. Proper lighting design in museums is essential for creating an engaging and immersive experience for visitors.

### **Illuminating the past**

As humans, the link to the past is crucial to understanding and defining the present and more so, the future (Smith, 2010). In one way or the other through history, culture, ancestry, among others, our pasts not only dictate who we are, but the general experience of humanity as well. Of all the tools that facilitate this process, lighting is arguably one of the most effective, illuminating not only physical spaces but also our understanding of history as well (Johnson & Brown, 2015).

With the goal of displaying historical objects effectively the evolution of lighting in museums can be split into two categories: basic lighting and more sophisticated lighting technologies.

Since ancient times, lighting has been used as a tool for storytelling and preservation of historical narratives (Clark, 2008). Early civilizations used fire and candles to light up cave paintings and artifacts therefore serving as a form of visual door to those eras (Green, 2012). This early use of lighting therefore addressed functional needs but in so doing also set the stage for the use of lighting for symbolic and storytelling purposes in historical settings (White & Garcia, 2016).

In the renaissance period, artists like Leonardo da Vinci and Caravaggio used techniques like chiaroscuro, a technique that used light and shade to add depth and feeling into what was drawn on the canvas (Brown, 2013).

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This advancement not only enhanced the beauty of the artwork but also allowed artists to paint historical scenes with more historical accuracy and a deeper sense of interaction (Smith & Lee, 2017).

During the 19th and 20th centuries, lighting technology made great progress with exploits of gas and electric lighting (Jones, 2005). These innovations changed the ways in which historical collections and artistic works are illuminated in museums and galleries, thereby improving their visibility and aesthetic value (Smith et al., 2018). Furthermore, artificial lighting enabled new approaches in preservation and verification, for instance, using ultraviolet light as a tool reveal hidden details in ancient manuscripts (Clark & Green, 2019).

The evolution of lighting systems can be seen in the switch from oil lamps and candles to LED and smart lighting systems. By improving visitor experiences and safeguarding collections museums have advanced historical interpretation at every stage of their existence. With the constant advancement of technological resources lighting will remain one of the most important components of museums helping to more clearly and successfully connect time to human experiences.

Even in the present day, lighting remains relevant in providing an engaging historical experience (Johnson et al., 2020). In terms of aesthetic experience, history comes alive through projection mapping and ambient lighting, engaging visitors' multiple senses to take them on an immersive journey back in time (White, 2021). As argued by Garcia (2022), such innovations do not only enhance education and culture but also promote understanding and respect for history. Looking to the future, more insightful research on the role of lighting in history is guaranteed to make our experiences of the past even richer and more meaningful to the present day (Smith & Brown, 2024).

## **II LITERATURE REVIEW**

### **A. Museum lighting strategies**

There are diverse classifications of lights usually applied in museum environment which have their own roles in contributing to the overall visitor experience and display. Ambient lighting provides overall illumination in the space, ensuring consistent visibility without overshadowing specific artifacts (Museum Lighting: A Guide, 2023). Accent lighting illuminate's special features and objects of interests, and is designed to provide special emphasis and create exhibit 'anchors' within exhibitions (Smithsonian Museum Conservation Institute, 2021). Task lighting is required when reading labels or for a detailed view of the artifacts will encourage visitors to interact with displays (American Alliance of Museums, 2020). Daylighting is also an important factor when the indoor and outdoor spaces are needed to be integrated, to create pleasant atmosphere inside the museum, and to provide the visitors more natural conditions to enjoy the exhibits (National Endowment for the Arts, 2019). These lighting strategies not only prove to be efficient in creating light on the artifacts, but they also greatly enhance the overall experience and public engagement within museums (National Endowment for the Humanities, 2022).

### **B. Lighting design considerations**

To have a successful lighting design, there are particular considerations that affect lighting on space, objects, and purpose. Color temperature, texture, form, viewing angles and layered light are factors that contribute to the whole. An understanding of these factors allows the fusion of lighting elements with an architectural designed space to create an effective and functional design for humans to interests and experience the space (Smithsonian Museum Conservation Institute, 2021). When those factors have been carefully met by the lighting designers, then exhibits can be effectively illuminated to enhance the details on them without compromising the environment of

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the museum (American Alliance of Museums, 2020). This approach not only meets the practical needs but also improves the design and functionality of the spaces in the museums that need to be perceived by the visitors (Hunt, 2009).

### *Color Temperature*

Color temperature is a factor of lighting design that explains how light appears warm or cool. The color temperature of light profoundly affects how we perceive art. Warmer light (lower Kelvin temperatures) can evoke a sense of nostalgia, while cooler light (higher Kelvin temperatures) can make artifacts appear more contemporary (shakya, 2018). Kelvin is the appropriate unit for color temperature with a scale from zero to 8,000K. Warm light ranges from yellow to red-tinted light that is in the range of 2,500 to 3,500K, this color temperature is perceived as being “warm and cozy”, high pressure sodium and incandescent lighting fall in the warm color temperature range, as well as lighting ranges from 2,950 to 4,100K (Hunt, 2009). Cool light is observed as blue to white hues, a cold and sterile “feeling” is usually associated with 3,600 to 8,000K, the higher color temperature is suggested in special applications lighting where color discrimination is significant (Licht, 2002). This aspect of lighting is pivotal in shaping the visitor’s experience (Hunt, 2009).

### *Form, Texture, & Angles*

Buildings are impacted by the structures and areas that interior designers and architects create. Most viewers experience either positive or negative effects from lighting but they are unable to pinpoint what caused the effect. To enhance the experience, a lighting designer must use the right angles of light to highlight architectural details. In addition to materials and finishes, ceilings, walls, floors, and other features can become surprise elements for lighting in a space (Karlen & Benya, 2004). When the lighting and architecture are not compatible, the viewer feels the negative experience by noticing glare, the brightness or darkness of an exhibit and how easy it is to see artifacts (Hunt, 2009).

These shapes and textures in a museum are essential to the light and the artifacts. While designing the lighting for a museum the viewing angles and luminary angles are taken into account. According to IENSA standards, luminaires are aimed at a steep angle, zero to twenty degrees in front of the surface to emphasize the texture or design details (Rea, 2000).

### *Layering Light*

By stratifying light, lighting design attains composition and a comprehension of visual aesthetics. All layers work together to create a unified design with each layer fulfilling a purpose. In museum lighting design, the ambient, task, focal, and decorative layers contribute to the overall aesthetic of a space (Adams, 2018).

The ambient layer encompasses the general lighting of a room, providing orientation and allowing movement through space. It typically maintains lower light levels compared to task lighting (Berman, 2014). Task lighting layer, such as down lights or pendants, is designed for specific activities like reading or writing, and its intensity contrasts with ambient lighting to create dramatic or relaxed atmospheres (Cuttle, 2017). Low ambient and high task light level, gives the space a more dramatic feeling while high ambient and task light levels create a more relaxing and cheerful focus (Berman, 2014). Focal layers are crucial for highlighting architectural details, artworks, and displays, they are designed to draw attention to specific objects or features without emphasizing the light source itself (Nikolaou, 2019).

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Track lighting is a common type of focal lighting due to its flexibility in directing light precisely where needed (Mardaljevic, 2015). Decorative layers are often referred to as the "jewelry of architecture," providing ornamental value to a space, these fixtures including chandeliers, sconces, and pendants, enhance the aesthetic appeal of the environment without being primary light sources (Rea, 2014). These combinations of layers, with different light levels, create a complete lighting system, all these layers should be in place to achieve a successful museum lighting system (Hunt, 2009).

### **C. Lighting systems in exhibition**

The most important lighting systems used in exhibition rooms are: luminous ceilings with opal glass enclosure (diffuse light) or satinised and textured glass (diffuse/directional), indirect luminaires (diffuse), cove luminaires (diffuse), wallwashers (directional or diffuse/directional), and spot lamps.

#### *Luminous ceilings*

The idea of luminous ceilings stems from a desire to imitate daylight. Luminous ceilings deliver light which is particularly suitable for painting galleries – predominantly diffuse with an opal enclosure, partly directional with enclosures of satinised/textured glass (Shakya, 2018). Opal glass helps in reducing glare and shadows while providing a soft, ambient illumination suitable for general areas, Satinised and textured glass ceilings on the other hand offer a combination of diffuse and directional lighting effects, they scatter light across the room while also allowing controlled beams to highlight specific exhibits or artworks (Karlen & Benya, 2017). The light sources of choice are tubular fluorescent lamps arranged according to the structural grid of the luminous ceiling (Licht, 2002).

#### *Indirect luminaires*

Indirect luminaires direct light upwards towards the ceiling or walls, creating a soft, indirect illumination that minimizes harsh shadows and glare (Saunders, 2011). This diffuse, uniform light is predominantly used in rooms where no daylight enters, It is produced by suspended luminaires radiating light upwards (Shakya, 2018). In exhibition rooms, for example, luminaires for suspended power track systems are an option: they are inserted in the track from above while spots for directional lighting are accommodated in the lower channel (Licht, 2002).

#### *Cove luminaires*

Cove lighting fixtures are installed in recesses or ledges near the ceiling, emitting light upwards and downwards to wash walls with light, they provide a gentle, indirect illumination that highlights architectural details and artworks without causing direct glare (Moss, 2008). The cove luminaires most frequently used in modern museum buildings are models with housings which themselves form the coving, the main direction of light with cove lighting is closer to the horizontal than with a luminous ceiling and corresponds roughly to that of perimeter luminaires mounted in continuous rows (Shakya, 2018). The light is largely shadow-free. Linear lamps, generally tubular fluorescent lamps, are the most widely used light source, excessive luminance at the ceiling and on the upper part of walls causes glare and interferes with spatial experience (Licht, 2002).

#### *Wall washers*

Wall washers are designed to evenly illuminate vertical surfaces, such as exhibition walls where artworks are displayed, they can provide either directional or diffuse/directional light, ensuring that artworks are properly illuminated to enhance visibility and color rendition (Kelly, 2017). Wallwashers are used as individual luminaires or in continuous rows, favoured light sources for wallwashers include linear lamps: fluorescent lamps, compact



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fluorescent lamps in elongated designs, linear high-voltage halogen lamps (Shakya, 2018). The diffuse/directional lighting delivered by the continuous row arrangements that are possible with these light sources produces relatively deep shadows, especially along the horizontal edges of picture frames, the directional light delivered by individual luminaires with non-linear lamps, on the other hand, gives rise to additional shadows along the horizontal edges of a picture frame (Licht, 2002).

### *Spot lamps*

Spot lamps are adjustable fixtures used to focus intense beams of light on specific exhibits or artifacts, they provide precise illumination for highlighting details, textures, and colors, making them essential for creating focal points within exhibition spaces (Gordon, 2020). Reflectors in reflector lamps (used in luminaires with no reflector) or spots, direct most of the light emitted by punctual light sources in a defined beam direction (Shakya, 2018). Spots and down lights with spot characteristics can be fully or partially integrated into a ceiling (or wall) as recessed ceiling spots, Surface-mounted ceiling spots and down lights as well as spots for power track have visible housings (Licht, 2002).

## **III. RESEARCH METHODOLOGY**

To investigate the impact of lighting design on artifact display, series of case studies were conducted, focusing on museums renowned for their innovative lighting techniques, as well as analysis of existing literature on the subject. This section outlines the methodologies utilized, emphasizing case studies and existing literature, the research aimed to provide a comprehensive understanding of the relationship between lighting design and artifact presentation.

### **A. Case Studies**

Case studies form a pivotal part of this research methodology, providing detailed examinations of specific instances where lighting design significantly influences the presentation of museum artifacts. By selecting multiple museums or exhibition spaces with distinct lighting setups like the Louvre museum and British Museum. This study aims to capture a range of practices, strategies, and their impacts on artifact display.

### **B. Literature reviews**

A comprehensive review of existing literature on museum lighting design serves as a foundational component of this study. This includes scholarly articles, books, and reports that discuss theories, methodologies, and case studies related to lighting design in museum contexts. A good portion of the literature was sourced electronically and duly referenced. It supports the qualitative analysis by providing theoretical frameworks and comparative insights from global museum practices.

## **IV. FINDINGS AND DISCUSSION**

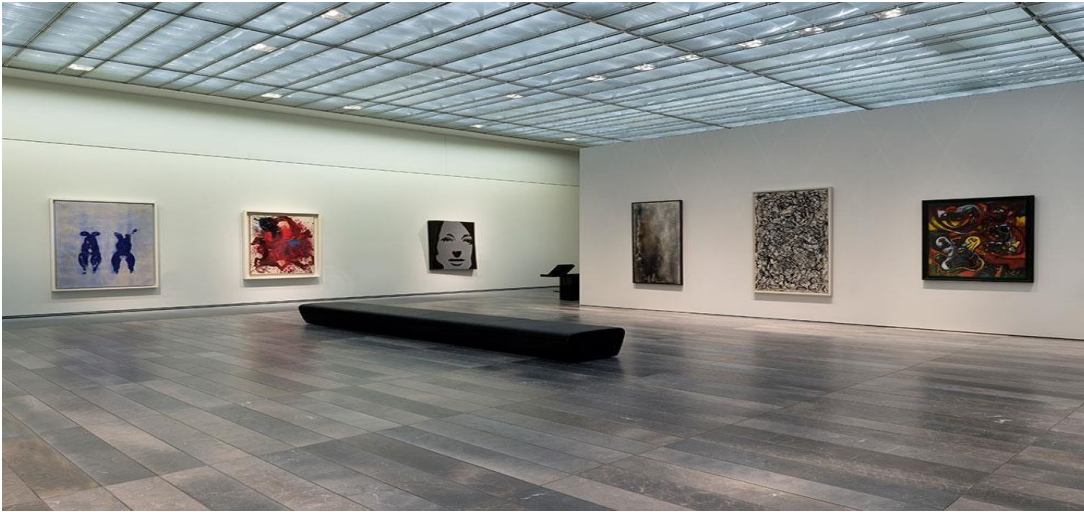
There are many examples of museums from all over the world where lighting design has been applied to the best effect in order to display the artifacts properly.

### **A The Louvre Museum**

To improve the visibility and atmosphere of its exhibits the Louvre Museum uses a combination of natural light and precise artificial lighting. All seventeen glass ceilings in the museum galleries and lateral windows offering views of the surrounding area allow natural light to stream into each gallery. In order to do this and prevent glare, glass mirrors are used to reflect sunlight and direct it into the gallery spaces, each is constructed from eighteen distinct kinds of glass panels. Afterward they created the intricate multi-layered design of the dome using BIM

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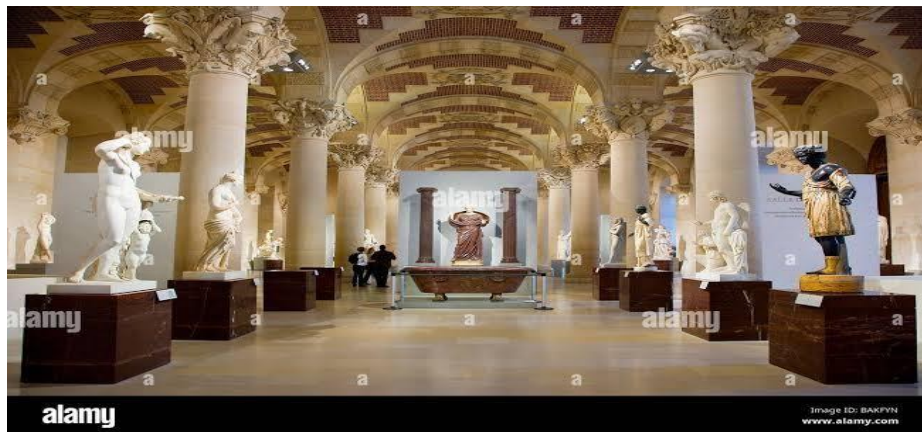
technology so that sunlight could enter the galleries without damaging the artwork. The light sensitivity of particular artworks was taken into consideration in order to achieve precise lighting levels in rooms that have both artificial and natural light. The three blinds on all windows and roof lights serve as a blackout blind in addition to two that diffuse light. When combined with the real-time data provided by light sensor output, they run automatically according to a schedule generated by modeling, the blackout blinds shield the artworks from potential damage in the event of excessive light levels. In order to provide the best lighting system possible for the artworks on display the glass ceilings combine artificial and natural lighting.



The museum uses a mix of track lighting and movable LEDs so curators can modify the lighting to meet the needs of particular exhibits and conservation efforts. It uses task lighting for reading areas, ambient lighting for galleries and accent lighting for specific artworks. In some areas day lighting is employed , with wall washers and spot lights to highlight exhibits. The Sculpture Gallery's sculptures are accentuated with dramatic shadows that draw attention to their three-dimensional features through the application of directional spotlights. This multi-layered method makes sure that delicate pieces are shielded from direct sunlight while also contributing to a dramatic presentation of artwork. By emphasizing the strategic use of lighting to evoke historical context and aesthetic

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appreciation, the lighting strategies employed at the Louvre have influenced other museums to adopt similar



techniques.

### B The British Museum

In order to emphasize specific artworks and enhance the visitor experience the British Museum uses a combination of ambient and directional lighting to enhance the chronological and thematic arrangement of artifacts. The courtyard area and the facades are illuminated by a crown of luminaires that surrounds the upper rim of the Reading Room, the luminaires combine directional and floodlight lenses to highlight artifacts in the court area. Karl Marx once conducted his literary research in the Reading Room which has been meticulously restored, the enormous dome is illuminated by Trion Uplights with 70W HIT high-pressure lamps.



Claude Engle the lighting designer used lens wallwashers with halogen lights and directional luminaires in the foyers, because they have the kind of light that makes the colors of the stone walls pop. The lighting design used by the British Museum is sophisticated and moves with the collections. Warm-toned lighting for example enhances the visitors immersive experience in the Ancient Egypt section by creating a sense of antiquity and mystery. To ensure maximum visibility without jeopardizing artifact preservation, various artifacts are highlighted using LED lighting systems with adjustable color temperatures. It includes task lighting for reading and educational purposes, accent lighting for specific artifacts and ambient lighting throughout, wall washers and indirect luminaires are frequently used.

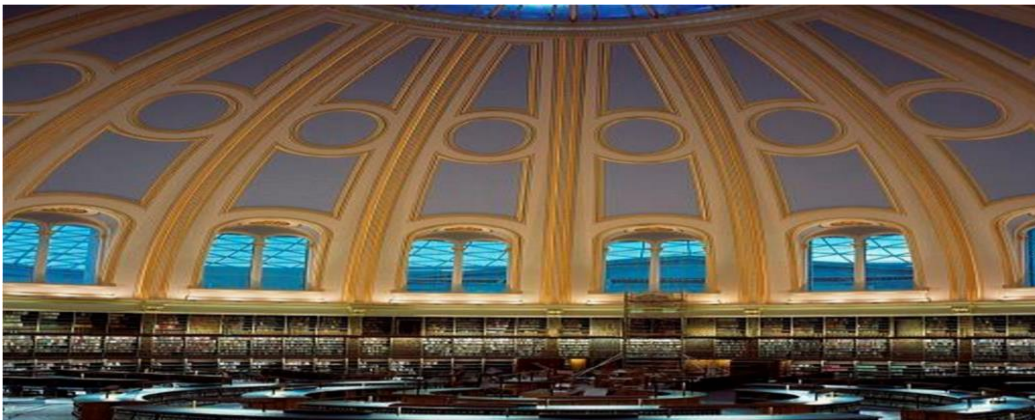


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**DISCUSSION**

The findings show that both the visual appeal and visibility of artifacts are improved by appropriate lighting. To draw attention to specific objects and manage the flow of attention in a specific direction directional lighting and intensity adjustments can be used. The experience of interpreting the artwork is improved by dynamic lighting effects such as color temperature change which can evoke particular eras or themes. The psychological effect of lighting design is that proper lighting can cause specific emotions, and facilitate deeper engagement with artifacts (Lee and Kim, 2019).



LED lighting is being used in the museum to improve exhibit visibility while also lowering energy costs and maintenance expenses. Lighting also contributes significantly to the conservation and preservation of artifacts by mitigating the harmful effects of light exposure. For example elevated temperatures from luminaries can cause rapid degradation of delicate materials and ultraviolet light can cause pigments to fade and deteriorate. Consequently, lighting design in museums uses processes such as UV filters, dimming controls, and temperature management to mitigate these risks (Canadian Conservation Institute, 2019). By balancing technical requirements such as light intensity and spectral rates with aesthetic goals such as illuminating form and texture, museums can create compelling exhibition spaces that optimize both preservation and visitor experience (Saunders 2011).

Lack of sufficient lighting makes it difficult to view and appreciate the unique and varied designs of the artwork in the museums display area. The lighting design creates a particular relationship between the items on display, the background and the surrounding environment depending on whether the exhibitions objective is to elicit an emotional response from viewers through persuasive inspirational or informative means. Museum visitors can be given a unique historical journey through the use of a variety of lighting techniques which will enhance their visitation experience. Collaboration between lighting designers curators and conservationists is necessary to ensure that lighting strategies balance artifact preservation with aesthetic appeal.

**V. CONCLUSION**

From enhancing the visual appeal of objects to influencing visitors' emotional and cognitive responses, lighting is essential in the illumination of history. When designing the content of a museum, the curators and designers should pay attention to the lighting that is used in the museum in order to capture the attention of the visitors. After all, it is said that proper lighting is capable of making a dead history come back to life. The frantic pace of the modern world creates the impression that we are always advancing, and there is rarely an opportunity to turn

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our gaze back and appreciate the past. However, in the case of a museum, it is the ability to look back that allows us to fully appreciate the present, and when it comes to illuminating the past, few things are as architecturally elaborate as a museum. Therefore, it can be ascertained that the choice of lighting also significantly influences achievements in the display of artifacts in a museum context and enriches the interpretation of the past. Museums must ensure that the type of lighting and its location is appropriate for the artifacts and that they can also incorporate new and interesting ways to light the exhibit halls to benefit visitors as well as enhance the specific features of artifacts in the process. With time, as the art world continues to evolve, embracing technological advancements, we can anticipate even more innovative lighting techniques that will further change how the public views and interacts with museum collections, so that the flow of our culture can be passed on to future generations.

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