

The effect of colored smart lighting in the design of metallic lighting units and selection of textile furnishings in natural reserves in the Kingdom of Saudi Arabia

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Abstract

The Kingdom of Saudi Arabia pays a great attention to the natural reserves, as the Kingdom's environment witnessed the complete extinction of several fungal organisms in the last hundred years. Thus, it placed them among the priorities of the Kingdom of Saudi Arabia's Vision 2030. This represents the entry into the subject of our research, whose problem lies in benefiting from the aesthetic and functional values of the changes of smart colored lighting to create virtual colors that simulate their counterparts in reality and achieve the attraction factor for textile fabrics and to reduce the use of light energy to protect the natural reserves. The agreement of the Red Sea Company in the Kingdom, which aspires to develop strategies to limit the use of the unnatural light in the Red Sea project at night, which is one of the most ambitious tourism projects in the world. It makes that to protect the reserves and realize the threats of the light pollution, in addition to confirming the importance of preserving environmental diversity to make it the most important tourist destination in the Red Sea, as well as enjoying a map of the dark sky reserves away from the radiant lights of the city. The importance of the research lies in classifying the aesthetic and functional light of the colored smart lighting units on the textile furnishings in the natural reserves in the Kingdom, and in shedding the light on the importance of using the modern technology for smart lighting, in addition to its role in protecting the environment of the Kingdom. The research aims at revealing the effect of colored light changes with modern technological methods and their effect on the selection of textile furnishings for the natural reserves in order to achieve the environmental balance. Also, it aims at choosing and specifying the types of fabrics suitable for each space according to the function, place and the environmental conditions. The hypothesis of the study contributes to create a virtual atmosphere that affects the surfaces of the textile fabrics and help to choose the appropriate furnishings according to the place and function. It also achieves the aesthetic values and the tourism attraction. The research applies the descriptive, analytical, experimental methodology where experiments to study the effect of the colored smart lighting with a power of (8 watts, 5 watts) and its impact on the various fabrics, (5) samples, through the effect of the appropriate lighting color for the reserves (yellow, green, blue, purple) at the best possible angle and distance, in addition to submitting proposals to (21) of specialists to fill out the questionnaire to reach the research results, the most important of which is obtaining the best color effect of smart lighting on the surfaces of the textile fabrics of the dim lighting with a power of 5 watts at night by 75% of the research sample. The appropriate choice of furnishings for indoor and outdoor spaces in hotels and resorts was also determined in order to achieve the aesthetic and functional values, as well as the minimum use of the light energy that contributes to protecting the environment and the biodiversity of the reserves.

Keywords Smart Lighting- Colored Lighting- hologram- - protecting nature reserves - choosing furnishings

Introduction

Color is a unique experience that cannot be achieved without light. Also, it cannot be sensed by the other senses (touch – taste – smell – hearing). Colors are not only intangible, but are constantly changing. When the surrounding conditions and place change, it is the same woven piece but in a completely different color. Thus, the color is not permanent or absolute, but rather changes by changing the conditions of the ambient lighting. Hence, the idea of the research lies in studying the effect of the different changes that occur to the colored light when the intensity of the illumination falling on it changes, in addition to creating a virtual atmosphere that mimics its counterpart in the reality and achieving the aesthetic values of the textile furnishings in hotels and night resorts, as well as helping to reduce the minimum limit of the light energy and give the opportunity to enjoy the dark sky and Protect the rare biodiversity of the natural reserves. It also helps to choose the appropriate furnishings for every place in the resort or hotel in the protected environment, save energy, achieve the economic dimension in the long term, and raise the environmental tourism attractio .

Concept of the natural reserves (Biosphere reserves)

Stated by Al-Shourbagy, et al (1999), the concept which adopted by the Wildlife Authority for the Natural Reserves: The sites allocated to preserve the natural environment resources in its original environment, especially those endangered species, rare species, or species that have a special value or significance. (Al-Duraibi, S. 2020 AD). It also identified by the International Union for the Conservation and preservation of Nature as “any land or sea area that is declared to protect biological, environmental or heritage diversity and is managed through legal means or other effective means.” (Net, 1)

To reinforce this concept, the Saudi Wildlife Authority seeks to protect rare and endangered wild species through rehabilitation, reproduction and settlement in natural reserves. It also directed its attention to expand these reserves to ensure the continuity of the environmental processes and to face the problems that threaten the operations in the environmental system of the reserves, such as the problem of the excessive use of lighting in the reserves.

Thus, during the recent years, the Kingdom has made global contributions in many to support the global trend to face challenges, the most important of which is Saudi Arabia’s initiatives to enhance the concept of protecting nature. The Red Sea Company in the Kingdom of Saudi Arabia has adopted light pollution laws by protecting our dark sky through imposing systems to limit the use of lighting units to the minimum. The study expanded to apply this through the analytical study using modern technology techniques of smart lighting and its impact on the selection of furnishings in the hotels and resorts of the natural reserves to protect the environment.

Classification of the natural reserves and its importance

In spite of the meaning of the natural reserves indicates to a Geographically defined area that distinguished by natural and cultural heritage, their classification depends on their nature, kind of life and the objective of life In 1982, The International Union for Conservation

of Nature classified the reserves internationally into 10 types and prepared their conditions in accordance with the international standards, as well as national requirements and characteristics. Then, the international community re-examined the types of the nature reserves after nearly 10 years of field practice and application. After reviewing the previous ten types during the Fourth International Conference for Natural Parks and Protected Areas in Venezuela in 1992 AD, which recommended to modify these types. The International Union for Conservation of Nature issued the new classification during 1994 AD as follows:

- 1- A natural reserve with a scientific nature.
- 2- National Parks: a natural reserve that is managed to protect the environmental and recreational systems
- 3- Natural Relic Reserve: a nature reserve that is managed to protect certain natural features.
- 4- Habitats Species Management Reserve
- 5- land and sea Landscapes Reserve ([Mahmoud.G 2021 AD](#))
- 6- Resource Management Reserve.

Its importance: The conservation of the biological genetic diversity.

- Performing meteorology.
- Conservation and preservation of natural resources.
- Regional developmental planning.
- Preserving the health of the environmental process.
- Activation of eco-tourism.
- Conducting research and studies.
- Public participation, education and training.
- Performing the environmental observations.
- Deepening man's awareness of the environment and improving their mutual relationship.
- Regional development planning. ([Iskandar d, 2022 AD](#))

Natural Reserves in the Kingdom of Saudi Arabia

The Kingdom of Saudi Arabia is considered one of the countries which is full of the natural reserves. It has big number of the reserves that distinguished by their various climate. The reserves are one of the prominent elements that attracted the tourists from all over the world. Thus, the kingdom increased their reserves because they are a homeland for a lot of living creatures that are endangered. It also aims at raising the level of tourism and maintaining the plant cover through establishing many of royal reserves to conserve the wild environmental life and the environmental balance. Figure (1) indicates to the most famous natural reserves in the kingdom of Saudi Arabia ([Net.1](#))

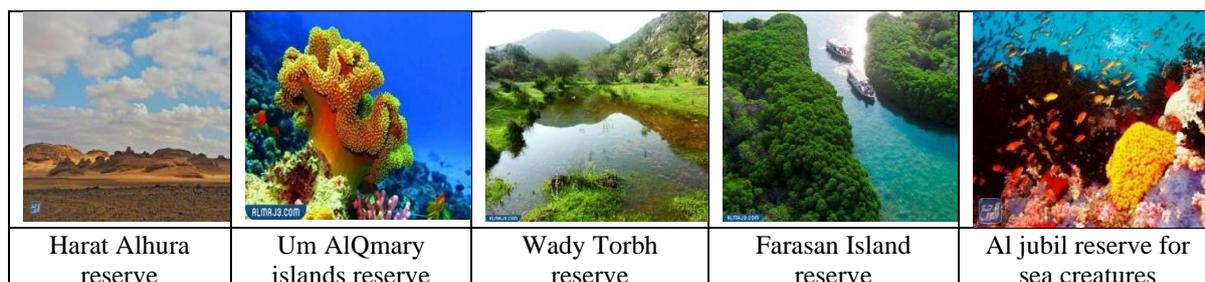


Figure (1) indicates to the most famous natural reserves in the kingdom of Saudi Arabia ([Net.1](#))

To conduct the biological and social studies and surveys required to prepare a system of protected areas, the Kingdom has sought the assistance of the expertise of the International Union for Conservation of Nature, where, in 1991 AD, the experts from the Union and the Commission prepared a document “A National System for the Preservation of Wildlife and Sustainable Rural Development in the Kingdom of Saudi Arabia” on the basis of which, the current declared network of the protected areas in the Kingdom, was established.

The system, which was recently updated according to the environmental developments, includes a proposal to protect 75 areas (of which 62 are land areas, 13 are coastal and marine areas).

It's planned that the center will manage 35 reserves (15 existing, 20 proposed); Provided that 40 areas (existing and proposed) are managed by other parties (Net, 2).

Figure (2) shows the map of the protected areas issued from the national center for developing the wildlife in the Kingdom.



Figure (2) shows the map of the protected areas in the Kingdom 2022
<https://www.ncw.gov.sa/Ar/Pages/>

The objectives of protecting the natural reserves

Protecting nature reserves aims at preserving the environment and biodiversity, in a way that preserves the environment and represents a pillar for the life and well-being of the people. It has several aspects of great importance:

- Preserving the natural environmental processes and relationships between the plant and animal kinds of the reserves by preserving all kinds in sufficient proportions for these relationships and the food chains that combine them.
- Preserving plant and animal genetic resources that inhabit the reserves. (Mahmoud H. 2021 AD)
- Environmental tourism investment of the reserve in a way that achieves the sustainable tourism and does not affect its biological components.
- Media and awareness investment of the reserve to contribute to raising the awareness of citizens and visitors of the importance of human partners in his life on the earth.
- Appropriate and organized economic exploitation of its vital resources by residents of the region. (Iskandar d, 2022 AD).

Smart lighting and its relationship to the design of metal units in nature reserves

The concept of smart lighting and its environmental impact

Institutions and organizations looking for excellence and survival to preserve the nature reserves are striving to keep pace with developments to reduce and limit the electrical energy used, in addition to the use of modern technology, which applies in the colorful smart lighting system that is witnessing successive developments in the age of information and knowledge. Thus, the smart lighting system is defined as "a lighting system that contains energy efficiency with drivers, digital sensors, advanced control algorithms, and unified communication interfaces".

(Al- Halabi, M, & Mahmoud, S, and Al-Alaymat, A,2022) It is also an adaptable system, which aims at improving the visual comfort to give aesthetic and functional advantages to improve the surrounding environment. It also includes solar energy, which is "renewable and clean energy", as it is a major energy source in removing the percentage of carbon used globally to reduce pollution and preserve the environment" (Net,(3)) , It can store the sunlight in groups called solar cells and placed high on the roofs, which is highly commensurate with the nature of the reserves in the Kingdom of Saudi Arabia. Hence, it is the best choice for the design of lighting units to suit the standards of nature reserves and how to take advantage of the falling sunlight in these areas, in addition to storing them in batteries to benefit from them in the artificial light of the lighting units, in addition to using solid light sources called semiconductors dichotomy radiating light (Light Emitting Didoes (LED), which is characterized by being environmentally friendly because of its advantages that help protect the environment and reduce the use of electrical energy. It doesn't "contain mercury like some other lighting, it is digital controllable, small in size, easy to be oriented, emits small amounts of heat, available in a variety of colors and shapes, reduces energy consumption and carbon emission (Sabry ,A, 2022) ' which makes the use of LEDs greatly helps to reduce the effects of pollution, in addition to protect and preserve the environment.

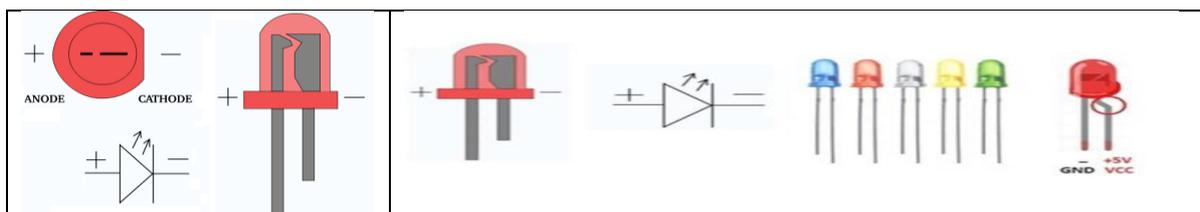


Figure (3) shows the shape and size of the LED-<https://www.eng2all.com/>

"Smart lighting control is a very important discovery, whose goals lie in how to control lighting units and save energy, in line with modern technology from mobile devices and the Internet" (Cheng, Y&, Fang, C,& Yuan, J, and Zhu, L, 2020). This can achieve the requirements of preserving the environment and protecting it from the light pollution.



Figure (4). shows Server-controlled devices in a smart lighting system -
<https://www.mdpi.com/journal>

One of the objectives and necessities of using smart colored lighting is to control the colors of light, as well as taking into account the psychological aspects of light affecting the environment of natural reserves using sensitive sensors for light. This can increase the sense of comfort and relaxation required by tourist places in the nature reserve resorts.

Types of Smart lighting

There are many types of smart lighting for controlling many devices, which can be provided with daylight sensors, according to weather conditions, motion sensors, speed sensors from the opposite side of the car way, sensors for light, movement, and music, in addition to the possibility of controlling the lighting time and colors through a device that connects these systems. This device is loaded with the Microsoft Windows operating system using mobile and Internet networks.



Figure (5) shows the integrated smart lighting system and how to control it using the mobile phone

The concept of Hologram and its importance

Hologram technology is "a technology distinguished by the ability to form a three-dimensional image in space Based on laser rays. The hologram is the final product of the recording process, and it includes the design "(Al- Halabi, M, & Mahmoud, S, and Al-Alaymat, A,2022) .A hologram technology depends on “holographic imaging, where this imaging takes place when a collision occurs between these two lights, the waves, and the object to be photographed, so the hologram device plans the data of the object and transfers the necessary information about this object to the imaging panel” (Alshereif, A,2022P1015).



Figure(6) shows the final look of the hologram technique-
<https://holoversethemeparkdistributor.com>

It can also be used in the indoor places in hotels in the reserves, with the possibility of achieving design creativity through the application of hologram technology in many visual arts, using modern techniques that increase three-dimensional visual vision. It is considered one of the tremendous technological developments, especially in the field of software. It has an effective role in changing the intellectual and design concepts of the internal and external blocks and spaces. With the technical development in the field of virtual reality applications, simulation and creating a virtual environment by deluding the recipient's eye who can use this technology in places that need relaxation and a feeling of enjoyment, such as the environment of the nature reserves using renewable energy. Hologram technology goes into improving the natural lighting, in addition to the aesthetic value of the hologram image, "It can be developed for use in architecture to improve natural lighting within space, as it works to shade and reflect the direction of sunlight falling on buildings and windows specifically, while allowing the scattered rays to pass through them and direct these rays deeply and greatly to the space to obtain more natural light. This is achieved by using semi-transparent holograms as three-dimensional optical elements, which enables the control of the solar radiation of the building without reducing its impact, so hologram technology saves electrical energy in addition to reducing the temperature inside the spaces, especially when used. This leads to reduce lighting costs. "More and deeper space"(Alshereif,A,2022,P1020).

Design specifications and standards that support the tourism environment, such as the nature reserves

Product design standards within the reserves

" Environmental standards, technological standards, functional and aesthetic standards"
 (Iskandar ,D,W,F, 2022) .

Environment-specific standards Research

Studying the nature reserves and their specifications as previously mentioned, then the location of the lighting placement, whether indoor or external, and the selection of furnishings to know the design requirements of the internal space in corresponding to the reserve and conflicts with the paths of local animals and birds in the nature reserve. Also, the standards include the use of environmentally friendly materials that are safe and harmless, and can be reused repeatedly, provided that their consumption does not cause harm to the environment. In addition, they include the suitability of local environmental product forms in terms of the cultural heritage, different climatic conditions, and the use of new energy and renewable energy as natural sources.

Technological standards

The use of new and renewable energies such as solar energy available due to the climate of the region, with the use of new technology available in the region such as smart colored lighting and the use of a distinctive type of lighting, which is LED, because it is characterized by environmentally friendly standards as mentioned previously.



Figure (7) shows the use of LED lighting at the Zoo as a nature reserve in Los Angeles-
<https://letsplayoc.com/posts/los-angeles-zoo-lights>

Functional and aesthetic standards for the design of lighting units:

Making designs and ideas inspired by the surrounding environment, benefiting from it and using materials characterized by sufficient durability to be suitable for repeated use, such as aluminum ores: it is used in the layers of internal and external lighting slides, one of its advantages "(Lightweight - flexible - aluminum corrosion resistance- is very good in most untreated environments, non-flammable to durable due to long life, recyclable "(Zainol, A, &Yazid, M,2019).

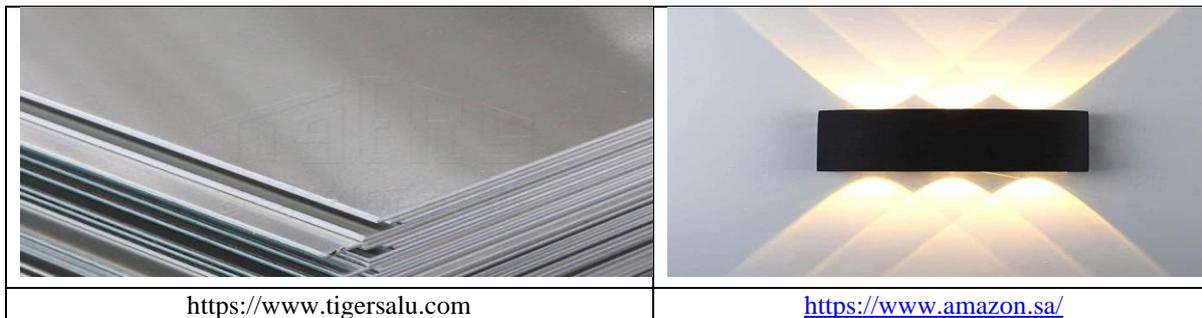
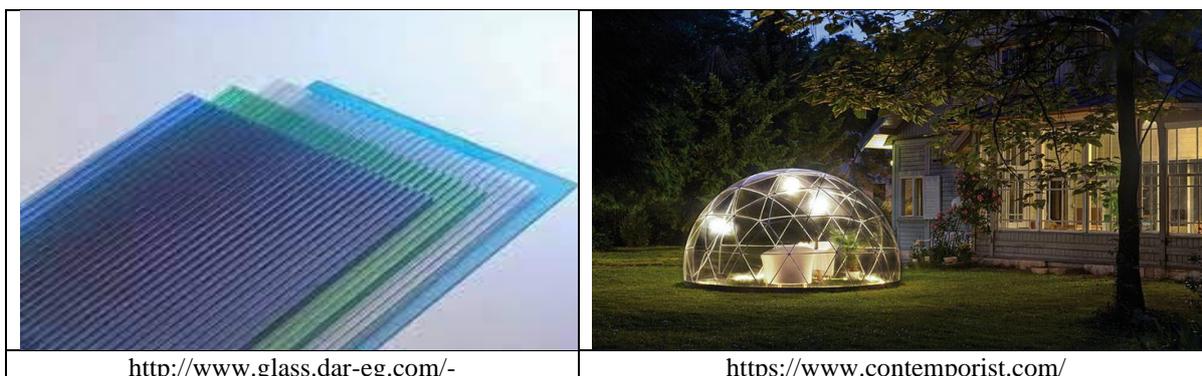


Figure (8) showing (8) a design for a LED wall lighting unit from Ecomax, made of aluminum to resist water and dust, for use indoors and outdoors, lighting color, warm light directed up or down in 6 lighting directions Painted black

Figure 8 shows the design of the LED wall light unit from Ecomax, made of aluminum to resist water and dust, for outdoor and indoor use, lighting color, warm light directed up or down in 6 lighting directions, and colored by black

Polycarbonate Material

It is a form of plastic that resembles glass sheets. It's available in a variety of transparent and opaque shapes. It is used in the layers of the internal and external lighting slides as an alternative to glass and its advantages include "(use - Flange P - flexible and easy to handle, cannot be broken easily and can be bent and withstands weights - a good UV blocker - has special coatings and colors produced by some manufacturers - can better resist cleaning agents of the panels - has good electrical resistance "(Youssef,A,& Ahmed,A, and Ali, A,2018).



A figure (9) showing the polycarbonate material in its use in outdoor spaces such as sanctuaries

Standards for the design of lighting units and their types

"Light is one of the most important formative values that allows the recipient to identify the different aspects of the artwork, because of its role in embodying the formal construction of the work" (Ali, E,2018), Lighting is one of the important components in the internal space

because of its impact on this space positively, or negatively, in addition to its impact on a group of other elements of the internal space.

lighting design is a science and art of the visual image formed and understood by the recipient. It occurs when the light rays are reflected so the design of lighting units needs to know a lot of lighting and how it falls on the surfaces. Thus, controls concerning the proper vision of the eye and its relationship with the physiological and psychological controls affecting living organisms in general is important in order to achieve a safe and healthy environment. All this must be known to the designer.

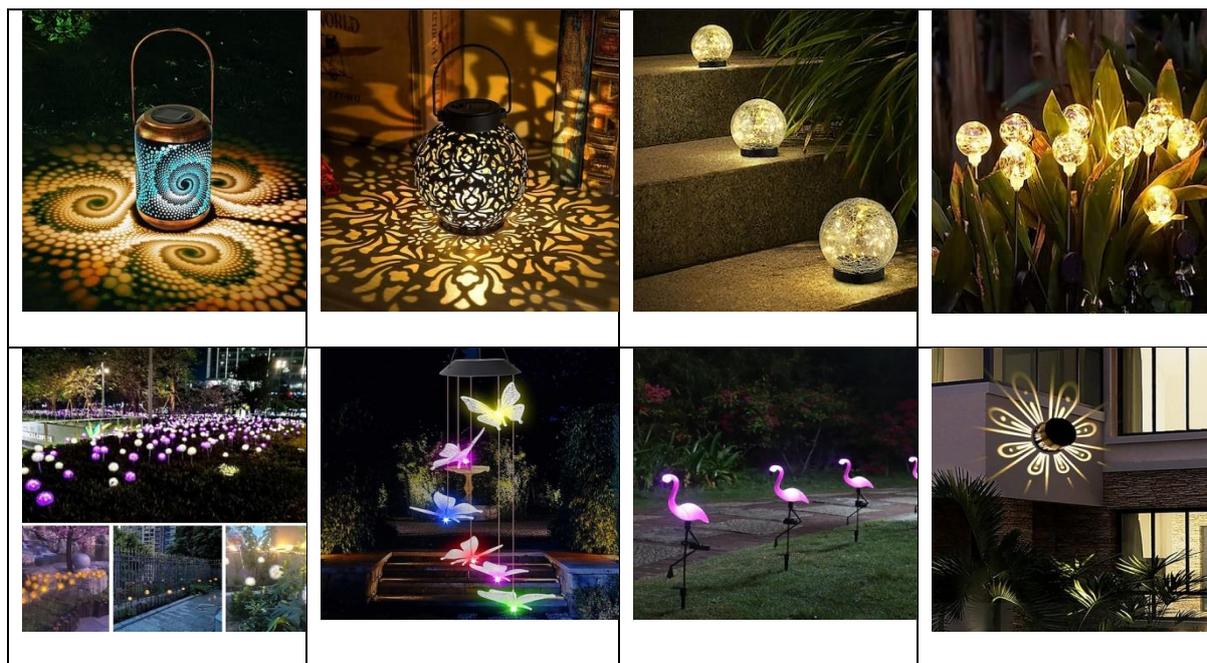
Raw materials and techniques used in textiles in the nature reserves in the Kingdom of Saudi Arabia:

The process of hand-made tenting technique: its handicraft depends on the recycling of environmentally friendly materials (cotton - staples - linen - tamping - natural dyes).

Environmentally friendly printing: which relies on printing on non-woven fabrics resulting from the recycling of textile waste. Digital printing, where the use of chemicals and materials harmful to the environment is reduced (Textile materials for experiments: (velvet - chenille - satin - poplin - print - marina - organza).

Design of indoor and outdoor lighting units and their relationship to smart lighting.

Lighting is divided into natural lighting and artificial lighting. The industrial lighting ensures external and internal lighting, and the latter is divided into functional and aesthetic aspects, which allows diversity in innovative designs and many forms. The study may be limited to analyzing the various forms of design of decorative aesthetic lighting units used for colored smart lighting, which appeared in the market in various forms of different materials and sizes, due to the different size of the LEDs that enter into the smart lighting. This led to the designer's freedom in creating designs for lighting units. The designs express the spirit of the place that no longer appears before, under the influence of the colors of lighting and music with the light control system for smart lighting as previously explained.



The figure (10) shows pictures containing a decorative outdoor lighting unit designed for gardens - <https://m.lightinthebox.com/>

The previous photos show decorative external lighting units that are designed for gardens whose shapes differ from nature in the form of swans, butterflies, and flowers. They are characterized by the use of smart colored lighting using waterproof materials and powered by solar energy with a power of 3- and 2-watts using LED lights, and processed aluminum metals.



The figure (11) shows some pictures that contain a decorative interior lighting unit - <https://castrolighting.com/>

These units are designed for walls and hangings. They are used in dining areas or in the corners and walls of rooms and reception areas, especially for the hotels of the natural reserves. They are characterized by the use of colored smart lighting with a power of 2 and 3 watts using LEDs.

The design criteria for lighting units are summarized as: "Luminance level, parallel lighting, glare reduction, shadow and shadow direction, light color, visual task setting, lighting quality. Darkness is as important as light, making use of natural light as much as possible" (Al-Gharbawi, F, 2019).

Physiological and Psychological Effect of Light on Humans and Living Organisms in Nature Reserves :

The designer of lighting units has many responsibilities when choosing the appropriate light for the space and also when directing the color luminance commensurate with the lighting and colors of the artistic board or pieces of furniture and furnishings. The light affects psychologically by the occurrence of internal psychological sensory emotions directly or indirectly. Strong lights work to arouse the desire for movement, joy, and activity. On the contrary, the dim light gives a suggestion of sadness, boredom and calm, so the designer can employ these sensations in choosing the appropriate light and appropriate colors in appropriate space places according to the function of the place, whether it is a tourist, educational or health place. "The diversity in the use of lighting methods inside the space increases the sense of

happiness, and in the absence of alert or movement resulting from the determinants of the space, this leads to a feeling of boredom and monotony". (Al-Nour,k,2022) The intense light also causes a lot of damage, and can sometimes cause loss of sight, as I mentioned in one of the studies" (exposure to inappropriate lighting continuously, poor visual intensity, and this may reach opacity of the lens of the eye." (Ahmed,M,2018).

Table(1) *shows the psychological and organic effect of colors on humans and living organisms (Al-Gharbawi, F, 2019).*

Color	Psychological impact	Organic effect
Yellow	Optimism, confidence, self-esteem, extroversion, strength of passion, friendliness, creativity.	It inspires activity and strength and is one of the activating colors of thought-cells, and some of its degrees affect the occurrence of intestinal disorders. sedative , and is used in the treatment of
Green	Harmony and balance, love, comfort and reassurance, environmental awareness, peace.	some psychological and neurological diseases such as nerve fatigue and is effective in calming cases of insomnia and fatigue.
Purple	For spiritual awareness, inclusion, vision, luxury, authenticity, truth, and quality.	It has a good effect on the heart, lungs, and blood vessels and increases the resistance of body tissues.
Blue	Confidence, competence, serenity, logic, reflection, and tranquility.	Help to relieve nervous disorders and calm rebellious souls, relieve blood pressure.
Red	Physical courage, strength, warmth, energy, survival, fight or flight, motivation, excitement.	It increases the speed of the heartbeat, causes revolutionary emotion, and is one of the most nerve-wracking colors.
Orange	Physical comfort, food, warmth, safety, sensation, passion, and fun	Stimulating and exciting, it gives a sense of turmoil and immaturity.
Pink	Material tranquility and care, warmth, femininity, love, sexuality and species survival.	It affects the mind more than it affects the body.

Through the previous table and the study of the standards and requirements of the nature reserves, the best-colored light with positive psychological and physiological effects was identified to be exploited in the tourist attraction factor in nature reserves while preserving the environment of the reserve against the damage of colored light pollution within the practical study of research using colored smart lighting, technology, represented in LEDs to create a picturesque virtual atmosphere characterized by comfort and well-being which cover the functional aspects and achieve the tourist attraction factor in the Kingdom's reserves. They are represented in those colored lightings (yellow color lighting, green color lighting, blue color lighting, purple color lighting).

A study of the effect of colored smart lighting on the surfaces of textile fabrics:

Colored light

Color is a unique experience that cannot be achieved without light, and cannot be sensed by the other senses (smell - taste - smell - hearing). The color changes continuously by changing the surrounding lighting conditions. It is not permanent or absolute.

Colored light

It is a colored radiation resulted from the natural analysis of sunlight or other spectrums of different lighting lamps. Light has two properties: frequency, which means the number of waves, and the other is the wavelength, which refers to the distance between a light wave and the wave peak that follows it. (Idris H. 2019 AD).

Light and color

To understand how to see colors, you must first know the nature of light, which is a state of energy or has a behavior similar to light waves, which we see in different colors. When a ray of sunlight passes through a glass prism, it decomposes and produces refractions in the form of colors called the colors of the spectrum, which start with the shorter violet color towards the red color. These are the two poles of the colors that can be seen with the naked eye.

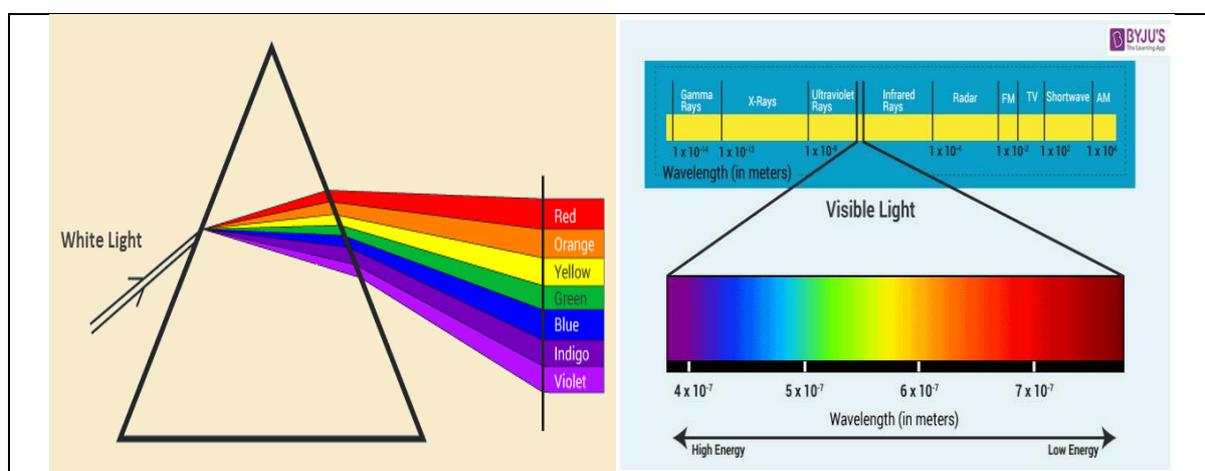


Figure (12) refers to the relation between the light and color- Visual natural colors - <https://www.alwanforart.com/2021/08/Color-wheel-by-Numbers.html>

The process of seeing color depends mainly on the light, which gives us a sense of shape, and space, so we can distinguish it. Things, in their outward appearance, is represented in two- and three-dimensional form as a result of light falling on them. The color of the thing that we see depends on two important factors: the state of absorption and reflection of the light, in addition to the type of light falling on the thing to be visible (Obeidat A. & Al-Radaydah b. 2019 AD). The color appears as a result of the effect of light, so the color can only be perceived and distinguished in the presence of light. The color value of the material and the degree of its brightness are affected by the changes in the properties of the light, for example when a colored light falls on a white surface, it appears in the color of the light falling on it, as in Figure No. (5) for organza. This is because of the light reflection from the cloth. However, if the light falls on a surface colored by a color other than the color of the source of the light, its appearance will depend on two elements:

- Properties of the material from which it is made.
 - The type and quantity of lights falling on it.
- Thus, the effect of the colored light becomes complex and causes some color changes that differ according to the wavelength falling on it. Rollo Williams has developed a simplified table, Table No. (1) (Idris, H. 2019 AD).

Table (2) refers to the extent of colored changes, which occur in the colored materials, under the influence of the colored light rays.

Dyeing colors	Lighting colors					
	Red	Green	Blue	Yellow	Purple-red	Greenish blue
Red	Red	black	black	red	red	black
Green	black	green	Black	green	Black	Green
Blue	black	black	blue	Black	Blue	Blue
Yellow	red	green	black	Yellow	red	Green
Purple-red	red	black	blue	red	Purple-red	Blue
Greenish blue	black	green	blue	green	blue	Greenish blue

Methods of achieving the effect of the colored lighting on the surfaces of textile materials:

- 1- LED lighting lamps
- 2- Colored filters.
- 3- Optical fibers.
- 4- Optical tissue.
- 5- Optical dye.

The application was carried out in the research using smart LED light lamps of 5 watts & 8 watts, to study the changes of the effect of the colored light on the surfaces of the textile fabrics that aim at reducing the use of the lighting to the minimum within the nature reserves and to choose the furnishings appropriate for the interior spaces of the hotels and the resorts of the reserves.

The effect of light on the textile surfaces:

The current study aims at choosing the furnishings appropriate for the interior spaces of the hotels and resorts in the natural reserves. It requires reducing the use of the light to protect the creatures and preserve the environmental balance. Accordingly, the researcher studied the types of textile fabrics, and they are divided into:

Opaque surfaces

They are those surfaces that absorb light and do not allow it to pass through, or they are the surfaces that reflect the light in different quantities and proportions. They are divided into opaque surfaces that absorb light, such as (velvet, printed, linen), and opaque surfaces that reflect light, such as (satin, chenille, and golden fabrics)



Figure (13) refers to the effect of light on the opaque fabrics that absorb light (prepared by the two researchers)



Figure (14) refers to the effect of light on the opaque fabrics that reflect light (prepared by the two researchers)

Surfaces that allow the light to pass: The surfaces through which the light is allowed to be passed and result in lighting effects depend on optical refraction. They are divided into fabrics with transparent surfaces (such as organza - chiffon ...), and semi-transparent surfaces such as (voile - poplin) (Idris. H 2019)

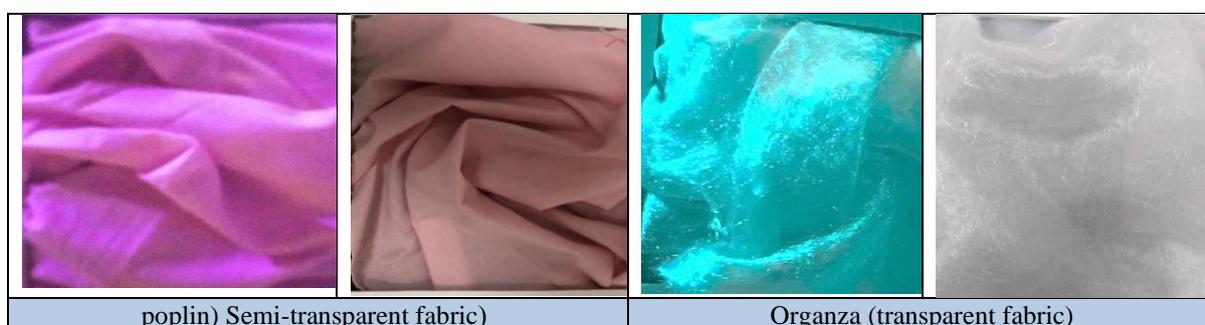


Figure (15) refers to the effect of light on the opaque fabrics that allow the light to pass through (prepared by the researcher)

Applied practical study

Exploratory Examination Experiments

Through the analytical and experimental approach, a first experiment containing several experiments was made. They are used to test the effect of appropriate light in the reserves on some diverse fabrics. 12 various samples with the effect of lighting with a power of 8 watts, 5 watts with a distance of 120 cm, a height of 120 cm for a sample area of 20 * 20 cm and a sample of 150 * 200 cm for fabrics. Three samples of each type were selected, besides the distances and angles were adjusted to reach the best visual vision and limit the lighting to suit the reserve. This is made by shedding Yellow, green, blue, orange light. These color lights have been mentioned earlier with their physiological and psychological impact on living organisms. The angle by which the light falls on fabrics has been determined by the position of the fabrics in the space of the internal space and these angles correspond to the direction of highlighting.

Practical experiences

After conducting the inspection experiments and benefiting from their results starting from determining the best suitable angle for projecting light and the best possible and commensurate distance with the area of the fabrics presented in the experiment, the practical experiments were applied in a semi-opaque room with the use of three types of fabrics, transparent, permeable to light) (semi-transparent, permeable to light)

Translucent, light-absorbing opaque), light-reflecting opaque.

1. Smart LED Light Source
2. Types of fabrics (Marigold, satin, organza, chenille, poplin).
3. Light intensity 8.5 W.
4. Lighting color (yellow, green, blue, purple).
5. Ambient light conditions, Dim lighting allows to see the effect of light on fabric surfaces.
6. Distance 120 cm and height 120 cm at a horizontal angle of 45 (which was determined based on the first inspection experiments).

Applications

Applied experiments were conducted to find out the effect of colored light on various fabrics on some products furnished in reserves (curtain, patchwork).

Model (1) patchwork Pendants, Opaque fabric absorbs light with high thickness ‘and design elements of protected environment.

Model (2) Printed curtain for medium-thick light-absorbing opaque marina material and design elements from the protected environment The first experiment is the effects of the colored lighting on fabrics (semi-transparent light permeable) (poplin).

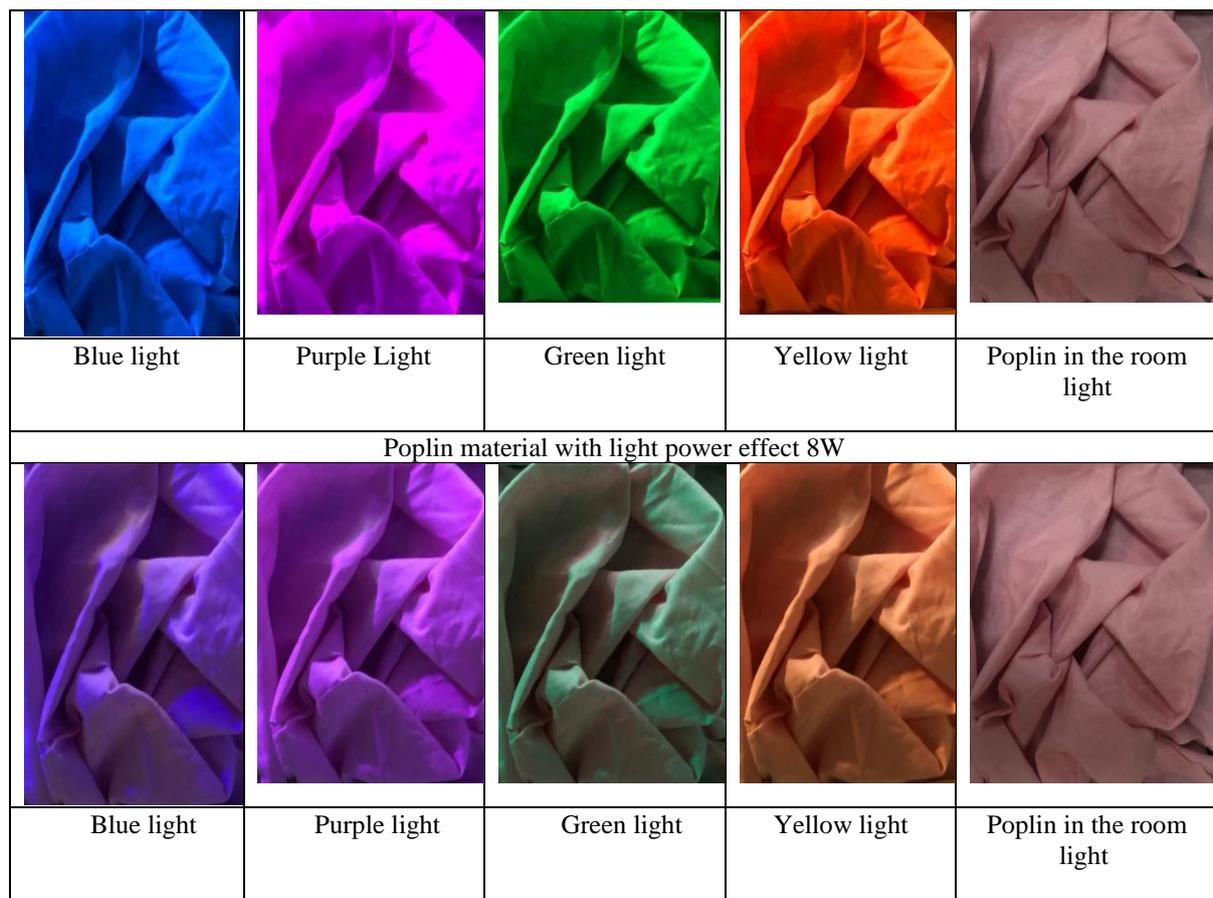


Figure (16) *Poplin material with the effect of light power 5 watts*

The second experiment is the effects of the colored lighting on fabrics (transparent permeable to light) (organza):

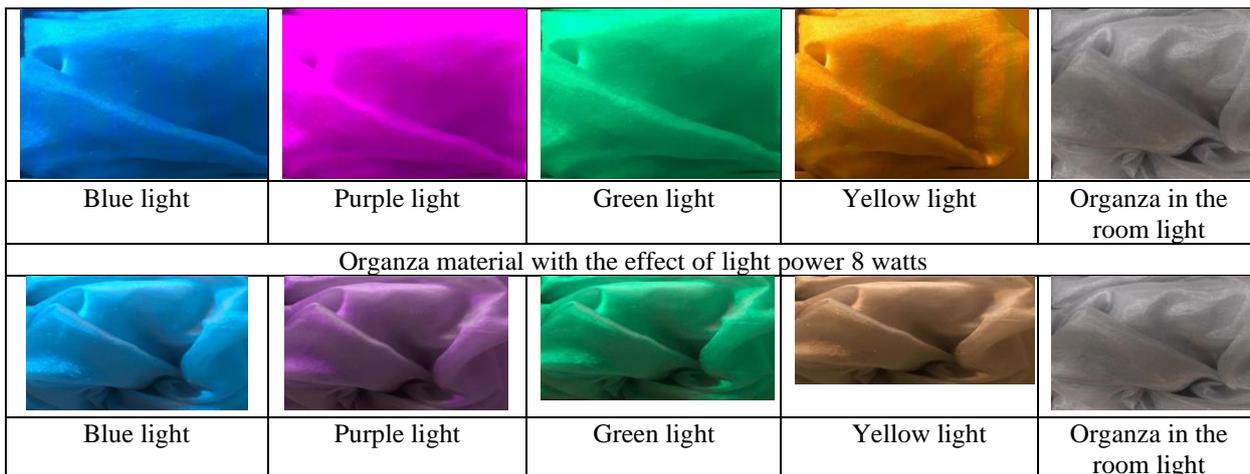


Figure (17) *Organza material with the effect of light power 5 watts*

The third experiment is the effects of the colored lighting on (opaque light-absorbing) Marigold fabrics:

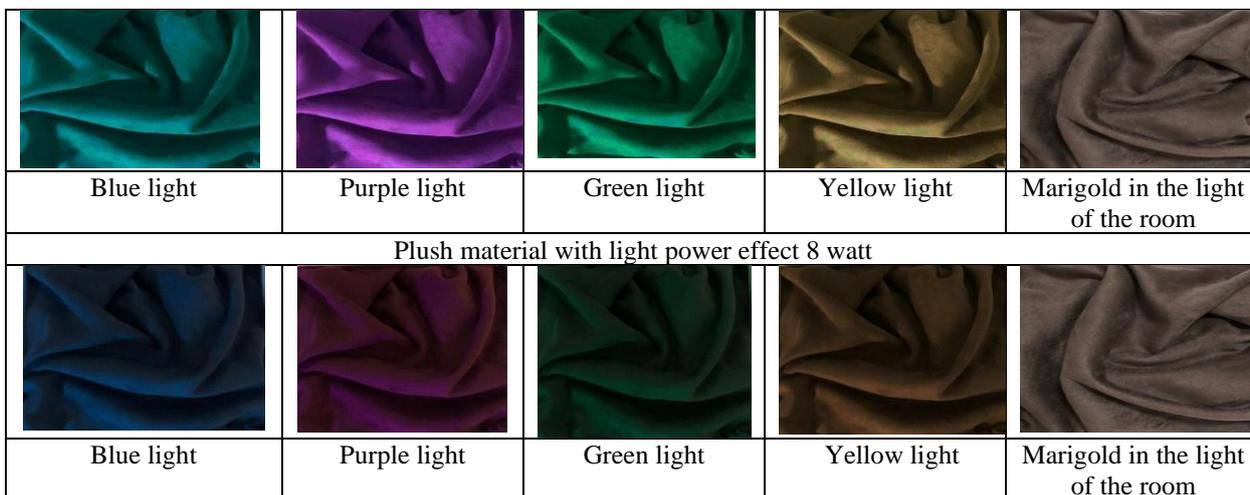


Figure (18) *Plush material with light power effect 5 watt*

The fourth experiment is the effects of the colored lighting on the opaque fabrics that reflect light (satin):

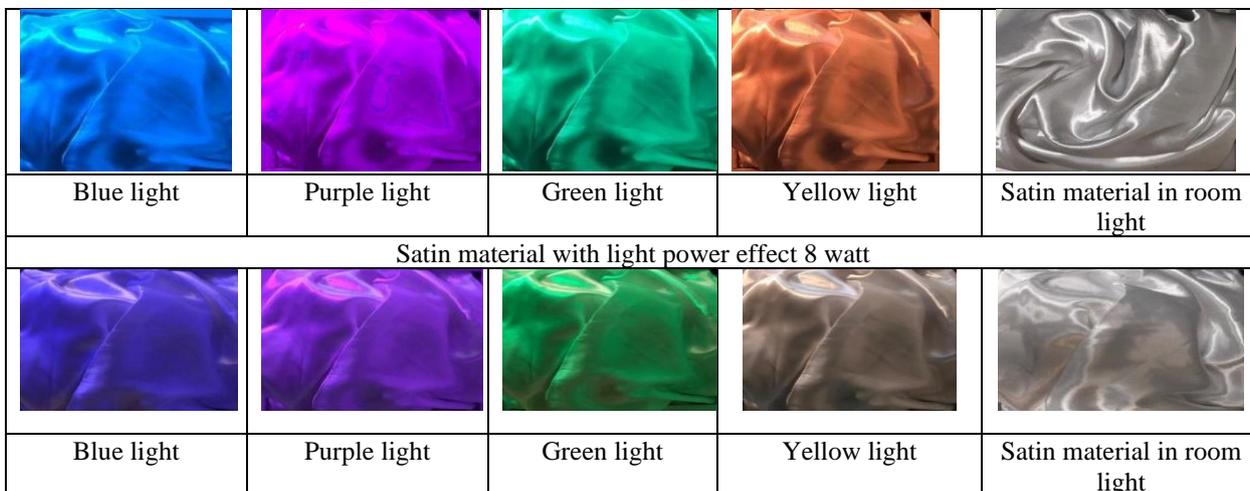


Figure (19) *Satin material with light power effect 5 watt*

The fifth experiment is the effects of the colored lighting on opaque fabrics that reflect light (printed chanelia):

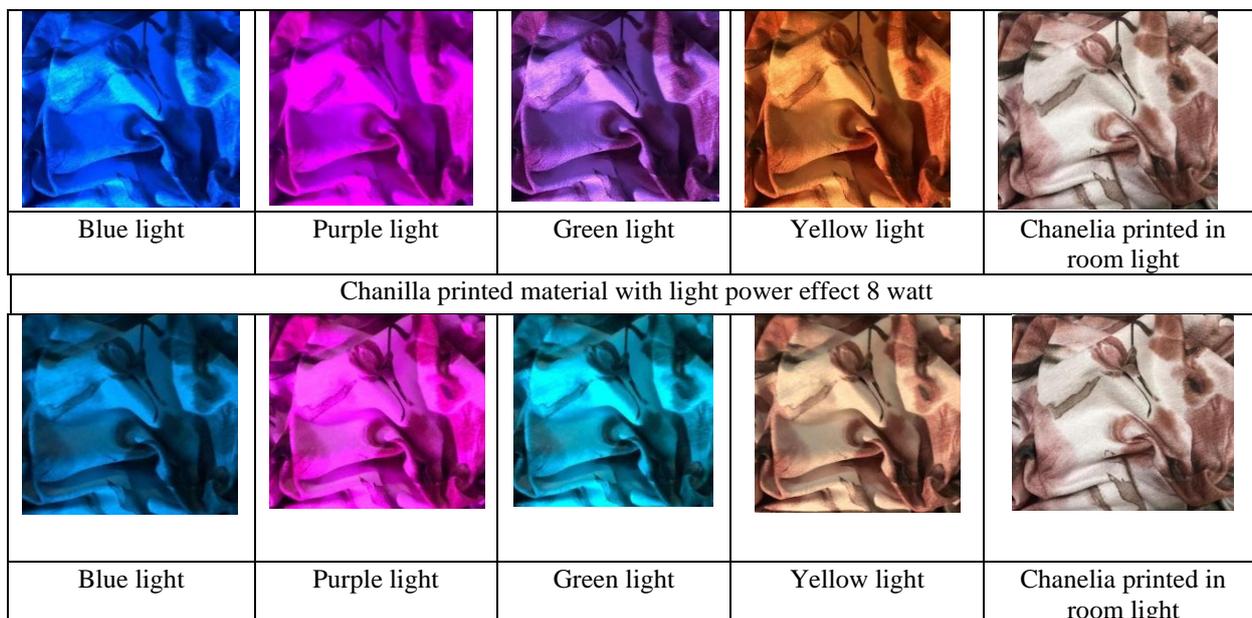


Figure (20) Chanelia printed material with light power effect 5 watt

Applications on some products furnished in the reserves (curtain, patchwork)

The first model: Patchwork pendants

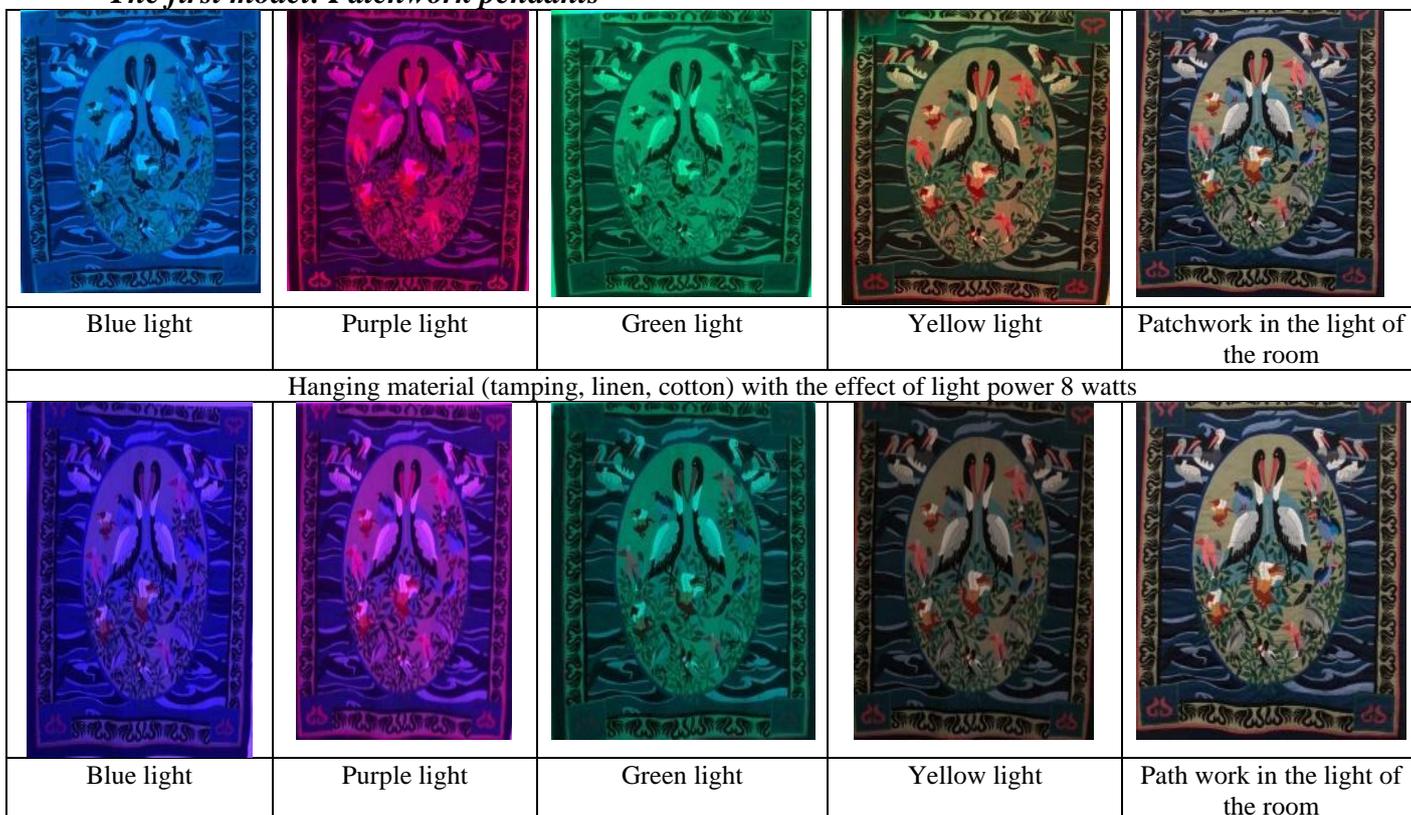


Figure (21) Hanging material (tamping, linen, cotton) with the effect of light power 5 watts

The second model is the curtain from Marina material:

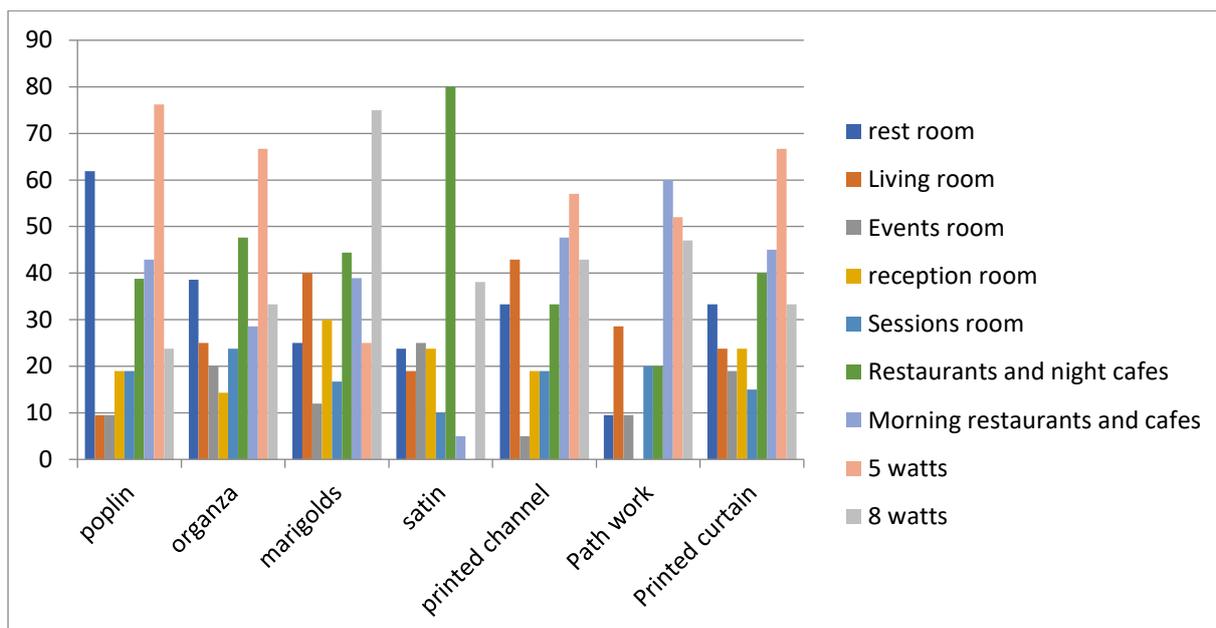


Figure (22) Marina printed material with the effect of light power 5 watts

Conclusion

Table No. (3) presents the final result of the questionnaire after taking the opinions of (21) specialists to choose the appropriate place for furniture and achieve the aesthetic and functional values in reserves.

	rest room	Living room	Events room	reception room	Sessions room	Restaurants and night cafes	Morning restaurants and cafes	5 watts	8 watts
poplin	61.9	9.5	9.5	19	19	38.8	42.9	76.2	23.8
organza	38.6	25	20	14.3	23.8	47.6	28.6	66.7	33.3
marigolds	25	40	12	30	16.7	44.4	38.9	25	75
satin	23.8	19	25	23.8	10	80	5	61,9	38.1
printed channel	33.3	42.9	5	19	19	33.3	47.6	57	42.9
Path work	9.5	28.6	9.5	52,4	20	20	60	52	47
Printed curtain	33.3	23.8	19	23.8	15	40	45	66.7	33.3

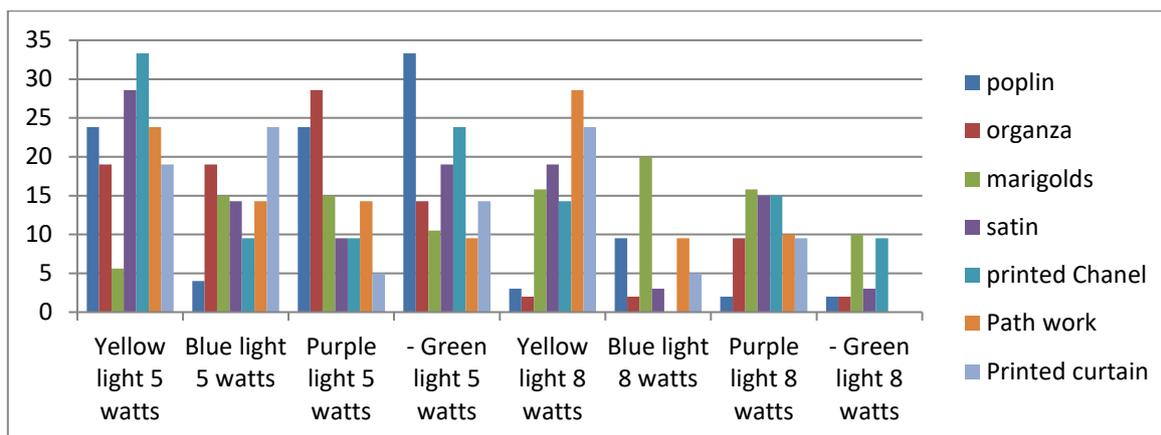


It is proved that:

- Light-transmitting and semi-light-transmitting materials (organza - poplin), and light-reflecting opaque textile materials - (Satin) is more suitable for restaurants and night cafes with dim lighting, while poplin is more preferred with bedrooms and to achieve the functional and aesthetic values.
- the printed medium thickness and heavy materials (printed chenille - printed curtains - patchwork) give a better color effect in the restaurants and morning cafes with dim lighting of 5 watts.
- The general conclusion of the experiments proved that by using dim lighting of 5 watts, the best color effect is obtained by using smart colored lighting by 75% of the research sample, which confirms the success of the effect of smart lighting with choosing the appropriate furnishings to reduce the minimum energy used in the reserves. Also, it achieves the aesthetic and functional aspect which Reflected on the economic dimension on the far term.

Table No. (4) Analysis of the final result of the questionnaire after taking the opinions of (21) specialists to reach the best outcome of the effect of colored light on the surfaces of the textile fabrics to reduce the minimum level of lighting at night while achieving the aesthetic and functional values:

	poplin	organza	marigolds	satin	printed Chanel	Path work	Printed curtain
Yellow light 5 watts	23.8	19	5.6	28.6	33.3	23.8	19
Blue light 5 watts	4	19	15	14.3	9.5	14.3	23.8
Purple light 5 watts	23.8	28.6	15	9.5	9.5	14.3	5
- Green light 5 watts	33.3	14.3	10.5	19	23.8	9.5	14.3
Yellow light 8 watts	3	2	15.8	19	14.3	28.6	23.8
Blue light 8 watts	9.5	2	20	3	0	9.5	5
Purple light 8 watts	2	9.5	15.8	15	15	10	9.5
- Green light 8 watts	2	2	10	3	9.5	0	0



Through the previous table, 56 photochromic results that mimic similar ones in reality out of the number (7) dye colors for textile raw materials using the two light powers of 5 W & 8 W, were obtained.

It is proved that:

- The resulting color differs according to the fabric's texture, thickness, and color. The soft fabric is bright without shadows. The recessed and prominent fabrics increase the shades, while the light fabrics give strong colors. The dark dyed fabrics give strong colors. When the color is formed by mixing the colored light and the surface of the fabric, a different color close to both of them is given.
- The effect of colored light with light illumination of 5 watts gives a better color effect with printed, light-transmitting, and half-light transmitting fabrics (printed curtains - printed chenille - poplin)
- The effect of the smart colored lighting with a power of 8 watts gives a better color effect with heavy and dark textile fabrics (dark heavy velveteen, and patchwork fabrics).
- The effect of colored lighting on printed furnishings is more effective than others on the unprinted ones.

The results confirm the importance of benefiting from the characteristics of both the textile material and smart colored lighting that is safe for humans and neighborhoods to choose the furnishings suitable for the job by setting the best place for each material, and about the aesthetic values by setting the most appropriate color effect that brings comfort and relaxation to the users of the reserve. Also, it improves the quality of life, and leaves a mental image for the environmental tourists and visitors of the reserve. This can increase tourist attractions while protecting the environment day and night, protecting rare endangered neighborhoods from the danger of light pollution, and preserving environmental balance, in the presence of the greatest harmony of technology for both humans, plants, and animals. This harmony cannot be achieved by the traditional technologies. It is also possible to benefit from the effects of the limitless color change for the smart lighting as a reference for designers to furnish hotels and resorts in indoor and outdoor places, choose the appropriate furnishings for the environment of the reserves, and achieve the dimensions for each of the aspects (economic - environmental - social), in addition to using the dim lighting for tourist destinations of the international natural reserves, in order to achieve the goal of research that is consistent with the goals of protecting the natural reserves.

Finally, the two researchers recommend conducting more experimental research to study the effect of the smart colored lighting on the surfaces of different materials. The two researchers propose a future study to obtain three-dimensional designs as a result of the virtual colors resulting from the effect of the smart lighting on the surfaces of two-dimensional designs that can contribute to developing the environmentally friendly ecotourism industry and serving the environment and industry in general.

Conflict of Interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data Availability Statement

The data used to support the findings of this study are available from the corresponding author upon request.

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