THE USE OF HISTORICAL ARCHITECTURE IN INTERACTIVE PERFORMANCES USING THE 3D PROJECTION MAPPING

توظيف العمارة التاريخية في العروض التفاعلية باستخدام تقنية الإسقاط الضوئي ثلاثي الأبعاد

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ABSTRACT

The research revolves around the digital revolution and its use in presentations through 3D projection of architectural objects and buildings with pre-defined dimensions using optical projection devices, and optical and sound artistic effects are added to interact with the model and give it a special advantage, Aesthetic and turn it into an interactive stereoscopic.
The research determines the three-dimensional projection planning technique and how to implement it and apply it to archaeological sites. It monitors some of the shows that are held with this technology, which provided the opportunity to hold huge shows in the open air which increase the demand for these places, as it can combine two features: attractions and the establishment of artistic interactive shows with a distinctive visual vision, in addition to increasing other activities that can be combined and overlapped with shows, such as shopping, tourism and competitions.

KEYWORDS

The 3D Projection Mapping ; Interactive performances ; Visual illusions

الملخص

يدور البحث حول الثورة الرقمية واستخدامها في العروض التقديمية من خلال الإسقاط ثلاثي الأبعاد للأشياء والمباني المعمارية ذات الأبعاد المحددة مسبقًا باستخدام أجهزة الإسقاط البصري، وتضاف المؤثرات الفنية البصرية والصوتية للتفاعل مع النموذج وإعطائه ميزة خاصة. جمالية وتحويلها إلى صورة مجسمة تفاعلية.
يحدد البحث تقنية التخطيط الإسقاطي ثلاثي الأبعاد وكيفية تنفيذها وتطبيقها على المواقع الأثرية، ويرصد بعض العروض التي تقام بهذه التقنية والتي أتاحت الفرصة لإقامة عروض ضخمة في الهواء الطلق مما يزيد الإقبال على هذه الأماكن، إذ يمكن أن تجمع بين ميزتين: عوامل الجذب وإقامة عروض فنية تفاعلية برؤية بصرية مميزة. بالإضافة إلى زيادة الأنشطة الأخرى التي يمكن دمجها وتداخلها مع العروض، مثل التسوق والسياحة والمسابقات.

الكلمات المفتاحية

الإسقاط الضوئي ثلاثي الأبعاد؛ العروض التفاعلية؛ الإيهام البصري

1. INTRODUCTION:

This research work addresses the issue of Technology as a means placed in the service of theatrical performance that opens new horizons for creativity and makes theater able to withstand other artistic means such as television and cinema, provided that awareness of the privacy of the theater and that it maintains a single case, which is the direct encounter between the actor and the spectator. And that it can accommodate all the arts (cinema, video, music, dance, singing, graphics) and make them auxiliary elements that serve the director's vision without controlling him.

The digital revolution is a reality that casts a shadow over all aspects of life. Theater comes, one of those parties that seek to adapt to the conditions of intellectual and technological postmodernity. The artworks that constitute the current of postmodernism are realized in the form of a series of anxious quirks and fluctuations of definitions and rules, which are evasive and theatrical in nature, and tend in some aspects to combine the arts and different branches of knowledge. There are many types of theaters that have used technology in the building of the theater. Some major companies have begun to use a new creative method that deserves a little ponder, as it is one of the most beautiful forms of advertising that depends on presenting offers through light projection on objects, which gives it a special creative touch.

The research problem is summarized in the extent to which the digital revolution and new technological capabilities can provide contemporary interactive performances that help increase tourist attractions and emphasize the cultural identity of each country.

The research aims to emphasize the importance of new technological capabilities to open new horizons for theatrical creativity and to study the forms of contemporary interactive performances in which architecture mixes with new light technologies.

The research methodology depends on two approaches in the study, the descriptive approach, and the practical analytical approach

1- The descriptive approach to collecting and analyzing information related to 3D projection Mapping technique, its importance in contemporary theater performances, and how to implement it and apply it to archaeological sites in Egypt.

2- The analytical practical approach by monitoring and analyzing some contemporary performances presented with this technique to determine the groups of plastic values in these presentations.

And reach the results and direct some recommendations to open the way for future research to study more experiments in this field.

2. INTERACTIVE PERFORMANCE

Interactive theater is an old theatrical form that has been re-adapted in the twenty-first century, that breaks the "fourth wall" that traditionally separates the performer from the audience both physically and verbally. It is not entirely based on dialogue; it is a visual theater. There are several forms Interactive theater can take. Interactive theater has been combined with new technologies such as light projection (3D projection mapping) to create contemporary interactive performances.

2.1 Some Examples of Interactive Performances using Light Projection

2.1.1 Polygon Playground 2008 – 2012:

Polygon Playground is an interactive art installation where graphics are mapped onto a multifaceted climbing/lounging structure. The visual appearance of the "Polygon Playground" changes continuously with the presence, movements and touches of its visitors. The object detects the positions and directions of people and reacts with evolving visual moods and graphic styles. Gradient ramps guide to the top plateau or offer space to sit and rest. The installation features a software aided 3D surface projection system to cover the object with a seamless 360-degree

projection mapping. An additional sensory system detects people's positions and proximity. (Figure 1).

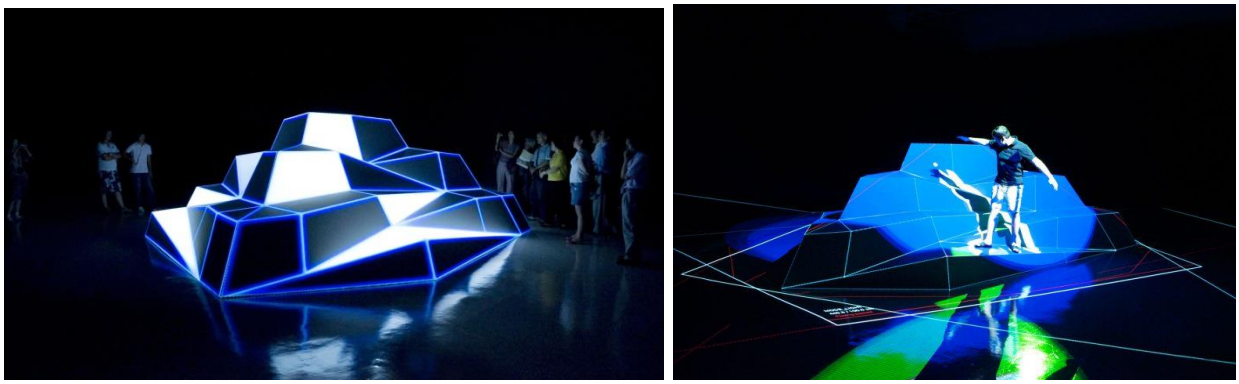

Figure 1, showing a large interactive entertainment model. Space of about 40 people To wander around and sit on it and explore its many facets.

2.1.2 Emil and the Detectives in National Theatre Olivier 2013:

Bunny Christie designed a stage using the video projections, where he did Street maps dissolve into neon grids, geometric but unsettlingly lopsided. There is a vortices eye that becomes part of the network of sewer tunnels. He transforms the skewed stage frame into a whizzing 1920s map of the city and a panorama of the nocturnal Berlin in lights. (Figure 2).

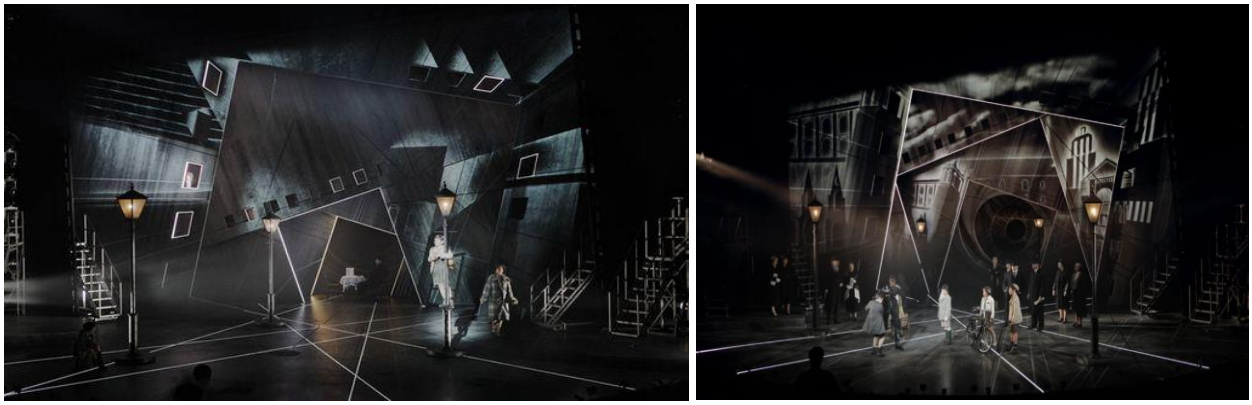

Figure 2, showing a black-and-white expressionist Berlin projected on to a Constructivist background. Director: Bijan Sheibani -Set design by Bunny Christie - Lighting Designer *Lucy Carter*

2.1.3 Romeo and Juliet in Saint Petersburg 2013:

The performance combines stereoscopic animations with actors appearing on the stage. Every person in the audience can see a three-dimensional image exactly matched with the actors. stereoscopic 3D performance, where it used innovative and creative technological solutions. (Figure 3).

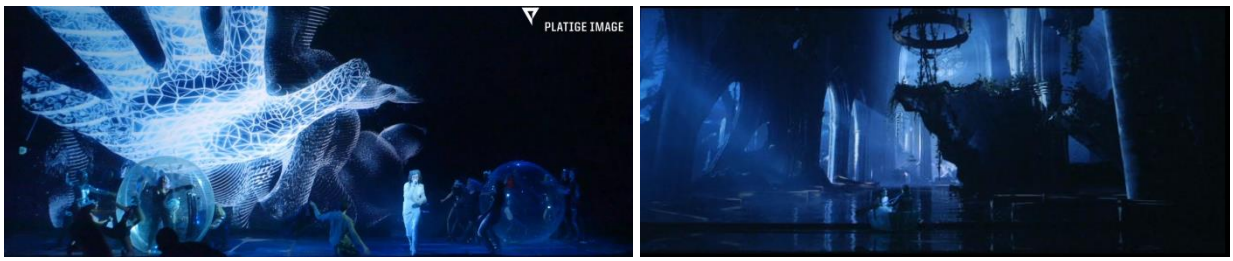

Figure 3, showing 3D Virtual Set Produced by: Platige Image, Musical Director: Janusz Józefowicz

2.1.4 A Midsummer Night's Dream in Brooklyn in 2013:

The show was directed by Julie Timer who created an interactive light show. Projection is tightly interwoven with lighting and set elements. The design features starkly contrast imagery that borrows its appearance from traditional silhouettes, cut outs as well as real flowers, ferns, roots and branches. The projection surfaces consist of a variety of moving fabrics, the back wall and thin air. All projected elements move, sway, rise or fall, blur or sharpen, appear and disappear to give the design a dream-like quality. (Figure 4 & 5).

Figure 4, showing the purple flower animated to bloom open, flutter and burst into purple color. Director: Julie Taymor - Scenic Designer: Es Devlin

Figure 5, showing the tree from which Puck emerges to create the trunk.

3D PROJECTION MAPPING TECHNOLOGY:

It is a technology that provides the ability to design a three-dimensional model of a building or model, add visual effects to it, and project it into reality space directly. (Figure 6)

This new creative technology depends on projecting three-dimensional drawings and shapes on buildings or objects with dimensions that are predetermined using projectors, and artistic effects of lighting are added to interact with the body and give it a special aesthetic, and sound effects or music clips are added. This technology helped a lot in large advertising campaigns and it became adopted by advertisers as part of their marketing campaigns. It creates limitless possibilities for creativity on any surface: buildings, vehicles, etc. Light projection is considered a very effective method in the contemporary theater industry, as it can be a projection of still images, moving scenes or light effects and other formations that contribute to enhancing the contemporary theatrical image. As projection and video technology seem to be popping up to explore interactive technology, new tools for projection include projection control systems, 3D projection, and infrared sensors.

The 3D mapping projection technology enables the design to be tested from any angle, and to make adjustments to it through design programs that wrap around the model, optical projectors and digital cameras that output production content to the show in the actual location.

This technology has witnessed tremendous growth in 2009, as international companies such as Samsung, Nokia and BMW made great offers using this technology, to advertise their products, which helped spread it widely.(Stanojevic, Milan . 2020)

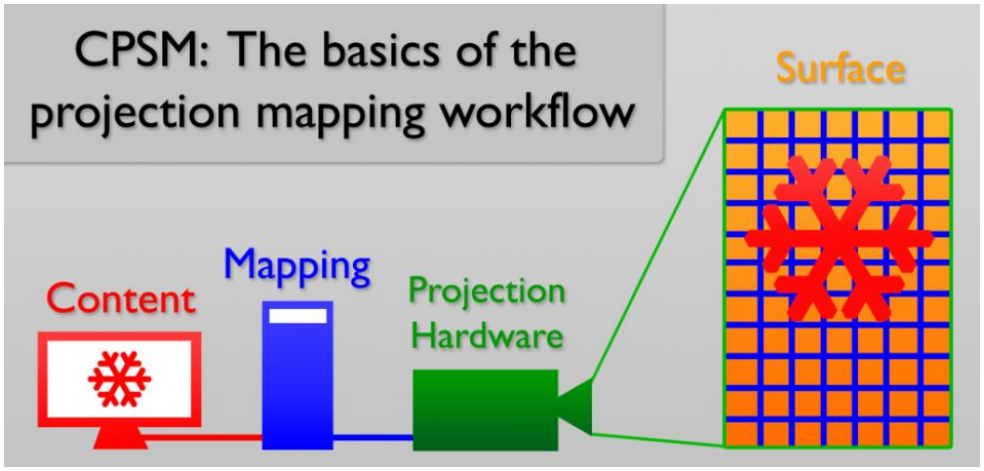

Figure 6, showing 3D Projection mapping technology

3.1 THE MOST PROMINENT PROGRAMS USED IN MAKING 3D MAPPING PROJECTIONS:

1- Resolume Arena
2- Mad Mapper
3- Heavy M Live
4- Mapio
5- Millumin. (LIME *ART GROUP*,2019)

3.2 THE PROCESS OF 3D PROJECTION MAPPING:

First: Creating a 3D model on the **AutoCAD** program free from obstacles, for a front image of the building used in the projection, with texture or a front projection image by means of a laser scanning of the building. The scanning is usually conducted about 30 days before the performance. The scanning lasts from 4 to 48 hours, according to the size of the surface of the building and complexity

Second: Lighting designers specializing in projection technology will turn the 2D digital drawing of the model to a design form so that he can apply performances and visual effects to the architectural model of the building. Where it uses the front facade of the architectural interface and enters the image into a digital visual effects and graphics programs such as **After Effects**. Then he selects the digital projection zone and prepares the architectural texture for the design.

Third: The event content is prepared from video clips, animations or visual effects that can be downloaded from **VJ Loops** and then returned again to the projection mapping specialist.

Fourth: The animation is blended into the texture of the image and then projector devices are positioned to determine the best location, rotation, dimension, lens size, and projection range.

Fifth: The pre-prepared digital performance is projected onto the surface of the real building by projection devices. All projectors should be placed next to each other and spaced evenly.(Kirkup .Peter 2019)

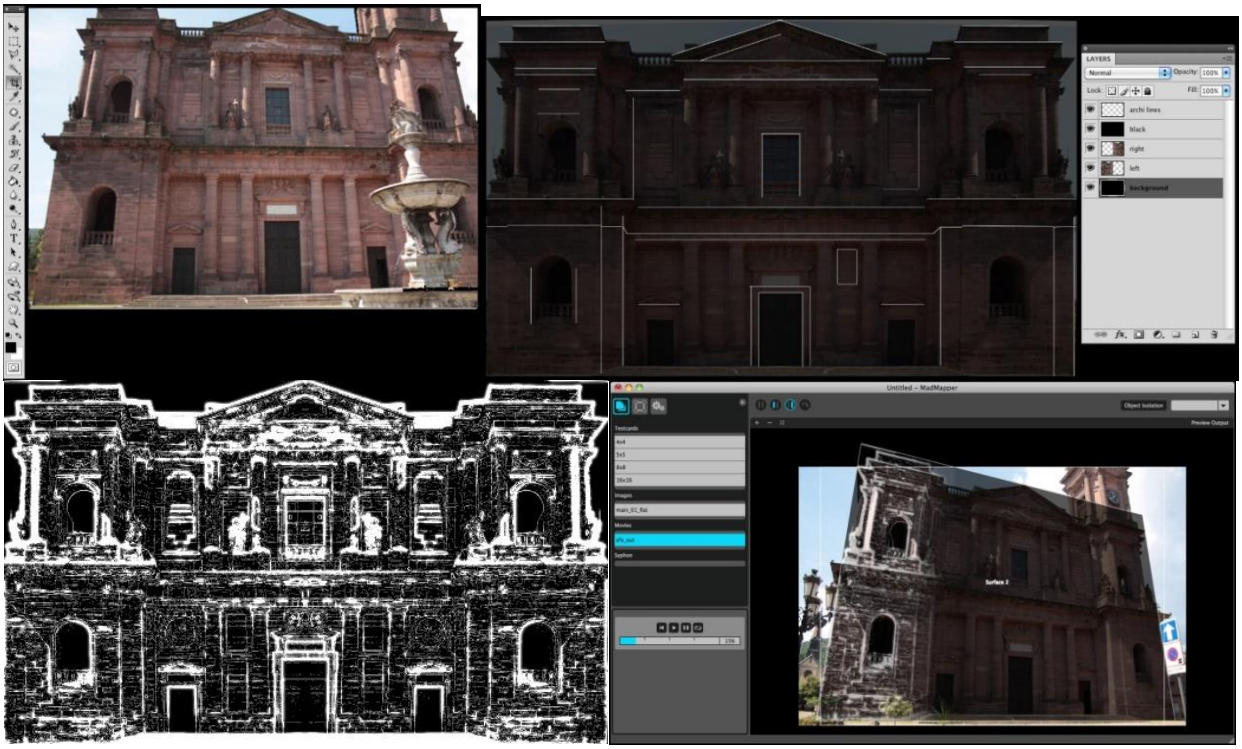

Figure 7, showing the steps needed to implement 3D projection mapping technique

4. PERFORMANCES USEING 3D PROJECTION ON HISTORICAL ARCHITECTURE:

4.1 THE FESTIVAL OF LIGHTS (FÊTE DES LUMIÈRES) IN LYON, FRANCE:

Every year in December, the Festival of Lights has been held in Lyon since 1852. This festival expresses its gratitude to the Blessed Virgin Mary who saved the city of Lyon from the plague, as every house in Lyon places candles along the outer windows and the entire city is lit with light that symbolizes the renewed identity of the city and displays its heritage. The festival lasts four days. The two main focal points of activity are usually the Fourvière cathedral, which is lit in different colors, and the Place des Terreaux, which hosts a different light show each year.

The festival attracts millions of fans, as designers create interactive light shows that attract spectators. The most prominent of which was presented in 2014 on the Place des Terreaux, where masterpieces of the Museum of Fine Arts were displayed on the facades of the building (Figure 8).

The Festival of Lights of Lyon quickly integrated the architectural video mapping in the program. Indeed, video mapping is the ideal technology for light and video projection, to set monuments in motion and sublimate the cultural heritage. (Shin. Nara.2014).

Figure 8, Masterpieces of the facade of the Museum of Fine Arts are displayed on the facade of the building Place des Terreaux 2014

The graphics and illuminations appeared beautifully for 3D mapping on the façades of the buildings of Place Antonin Poncet, Lyon, where a cosmic journey of "**Laniakea**" (a giant galaxy group identified by a group of astronomers, including **Helene Courtois** of the University of Lyon) formed by thousands of luminous globes was shown, clusters of luminous points, of stars, which like a galaxy, form constellations, then fall apart. (Figure 9) (Shin. Nara.2014).

Figure 9, showing the cosmic journey of "Laniakea" expand into a three-dimensional experience.2014, Place Antonin Poncet

In 2017, Nathanaëlle Picot, President and Artistic Director of Pixel n'Pepper, created a creative presentation of the character of a young girl named Enoha (Seven-year old) and her cat to tell a century of cinema through her vision, and relive great films in her own way. "Creating a likable character brings a little warmth and madness in 3D optical mapping," explains Nathanaëlle Picot, in a very large space like the Museum of Fine Arts, where the 3D animation makes the visual image less flattened. So, this what brings "a lot of magic and creativity" to the public (Figure 10). The site area, which combined City Hall and the Museum of Fine Arts, required fourteen projectors, most of which were an Epson 25K laser for the large area.

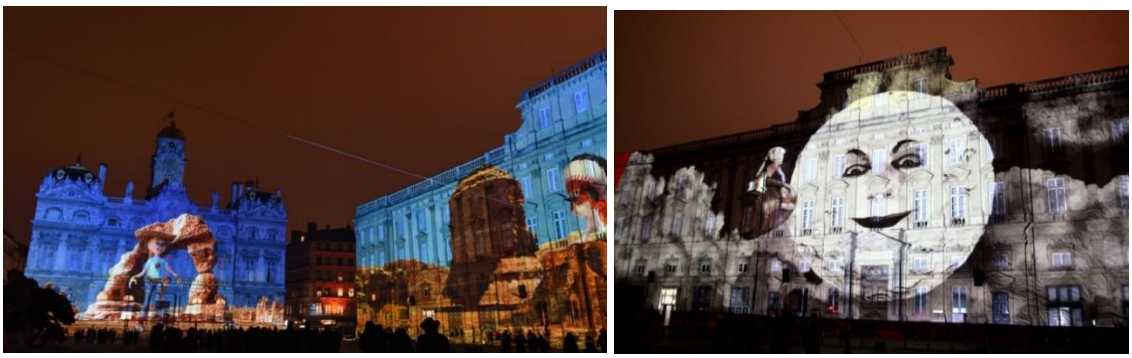

Figure 10, Show (Once upon a time) from the Festival of Lights 2017 in Lyon

4.2 Aura Show at Notre Dame Church In Montreal, Canada 2014:

Moment Factory (an award-winning multimedia studio renowned the world over for its stunning creations) created a performance showing the many works of art and architecture on Notre Dame Cathedral, With respect for architectural and religious heritage of the Church. The 45-minute AURA show uses lights and video projections to highlight Irish-American architect **James O'Donnell**'s design features for Notre Dame's Gothic cathedral of Lines height and soaring towers Implemented to attract the audience and enter them into a state of spiritual communication. The showcase is a 2-part multimedia journey that features both music and special lighting effects. The first part is a thematic route followed by a multimedia experience.

The show begins with a tour by the attendees inside the cathedral and discovering the beautifully lit artworks, then the light projections begin on the perimeter of the church from the inside surrounding the viewers from every direction. The orchestral notes then combine with the architecture of the building to create a 3D projection Mapping performance that captures the imagination of the spectators, for this reason AURA light colors enhance the detailing of the basilica for an interactive visual show. Stained-glass windows in Notre Dame express events from the religious history of Montreal, so in effect, it also highlights the history of the city. (Figure 11)

Figure 11, The light and sound installation is aimed to enhance the historic beauty of the church's interior.

Notre Dame's surface turns into glass. The beats of the music lead to streams of light through all of its intricate detailing painted on the ceiling. The visual transmission across the seasons leaves flowers in bloom, birds fly and leaves fall above the attendants and snow and ice cover all walls. (Figure 12).

To make this show, we need a year of musical composition and recording, four months of visual video production, three months of preparation and another month of mixing and real-time experience of the video. (design box 2017)

X-Agora (3D Map Creation Software) is used for making projection projections onto complex curves of church surfaces and sculptures. (Figure 13)

To create the various effects, 21 projectors were used, along with 140 lamp and four devices dropping laser and 20 mirrors. Complementing the visuals is an orchestral soundtrack, which was written by Troublemakers' Gabriel Thibaudeau and Marc Bell. The music in the soundtrack records a performance by thirty musicians, twenty instrumentalists and the Casavant frères basilica tube organ, which is over 120 years old.

Figure 12, It shows the walls of Notre Dame Cathedral as they turn into glass surfaces through which leaves, birds and nature appear to merge with the religious character of the church

Figure 13, shows a drawing of the walls of the Notre Dame Church from the inside using the X-Agora program, lines analysis, and 3D drawing of laser-defined areas of light

4.3 IMAPP (International Video-Mapping) 2016 Bucharest (Romania):

An international competition is held in Romania every year in September, in which the world's best projection artists present their work on the front façade of the Parliament Palace (built from the largest administrative buildings in the world) in front of a large group of audiences. The competition involved 23.000 square meters of projection surface, over 104 projectors and more than 2.000.000 ANSI lumens in front of an audience of over 65.000 people. (Figure 14)

Figure 14, showing the architectural façade of the monumental Roman Parliament Palace

Figure 15, showing the 3d video mapping on the architectural facade of the Parliament Palace

Artists create 4-minute, 30-second animations expressing themes appropriate to the architecture of the façade of the Palace of Parliament, Bucharest, Romania accompanied by sound effects to create an interactive visual presentation with the audience. (Figure 15)

The performance titled **Interconnection** (Winner of the Jury's Choice Award 2016) highlights the connection between all things, and the integration of the architectural characteristics of the building with moving visual images The show highlights that we are all part of a cosmic network and the human mind separates us from external influences according to a wrong perception.
The show expresses the amalgamation of the architectural element with art, animation, and different life fields such as physics, engineering, chemistry, space, etc. (Figure16) (Harris, Miriam 2016).

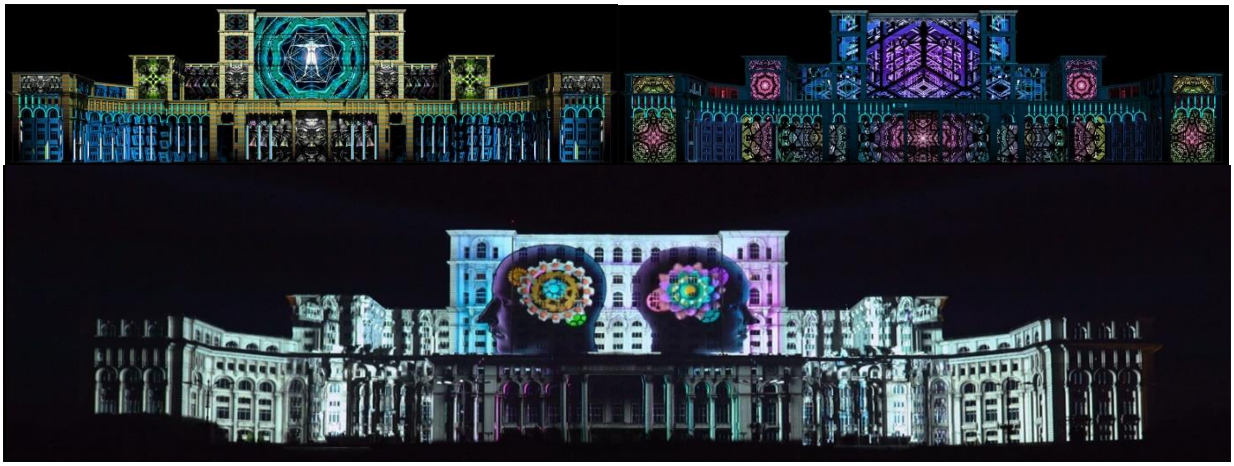

Figure 16, Integration of the architectural characteristics of the interface in the work of visual art. Director: Antonin Križanić, Visual Design: Antonin Križanić, Dávid Vígh

4.4 LUMA Light Festival 2017

LUMA is the only visual arts festival in the United States in Binghamton, New York. In 2017, a light show entitled (Timeless Tales) was held on the façade of the Carnegie Library of Historical Treasure. The show featured fairytale and epic stories, featuring Disney stories Little Red Riding Hood, Sleeping Beauty, and the Snow Queen. (Figure 17 ,18)
The festival takes place every year at the beginning of September and continues for three days and attracts more than 35,000 people every year. Also 30 3-Chip DLP laser projectors are used in place to operate the LUMA.

Figure 17, Alice in Wonderland displayed on the Carnegie Library 2017

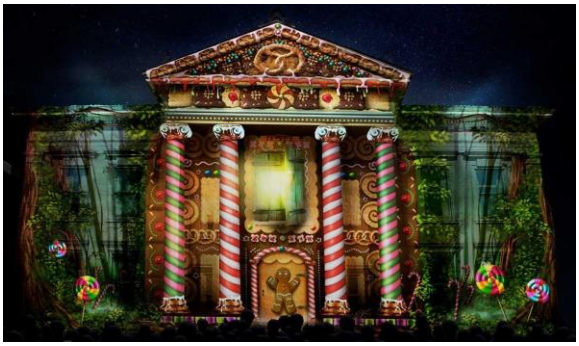

Figure 18, a colossal candy-laden gingerbread house. the Carnegie Library, New York 2017

4.5 Festival of Lights in Berlin 2019

In October 2019, The Festival of Lights was held in Berlin, with the slogan "**Lights of Freedom**" marking the "30th anniversary of the fall of the Berlin Wall".
The festival lasts for ten days, and the International artists of the 3D mapping presented audience with Creative graphic Tales about the most beautiful and famous landmarks of the city. (Figure 19)
Berlin Cathedral was turned into a projection screen for the renowned art of the Festival of Lights. Colorful and meaningful messages were displayed on the monumental building. For the anniversary of the festival in this year, director **Birgit Zander** had invited international artists to create a very special motif for 15 years of the Festival of Lights. And this, even though the landmark at the **Lustgarten** is not a simple projection screen. Its dark façade with its many depths and heights is a tricky challenge. Each motif must be adapted in an elaborate process and cut to fit the Cathedral.

Figure 19, Berlin Cathedral in the Festival of Lights 2019 the show featuring pictures by other international artists

Also, the facade of the **Neuer Marstall** (a listed historic building in Berlin, Germany. The building erected in 1901 in the neo-baroque style) was represented at the Festival of Lights as a projection location for the House of Nature. The projection focused on the beauty of our planet. Nature and culture merged together. A unique view of the earth was created from outer space. Fascinating animal shots alternated with landscape shots. At the end of the projection, the facade of the New Marstall was transformed into a beautiful mapping that merged the diversity of nature with Berlin's urban landscape. The preservation of unspoilt nature and the associated themes, such as climate protection, have for many years had a firm place in the Festival of Lights. The special light art project draws attention to topics such as climate and species protection, environmental pollution or sustainability and encourages viewers to reflect and rethink. (Figure 20). The Bode-Museum was also used in the Festival of Lights as a projection location for paintings by international artists. (Figure 21.22)

Figure 20, The Neuer Marstall 2010 -animal shots alternated with landscape shots

Figure 21, "Hey Honey" painting by The well-known musician Udo Lindenberg displayed on the facade of the famous Bode-Museum Pictures by prominent artists transformed the museum into a special canvas.

Figure 22, The painting "One Morning in Berlin" in the "House of Art" at the Bodemuseum by the artist Otto Waalkes

5. THE USE OF TECHNOLOGY (BUILDING MAPPING) IN THE ARAB WORLD:

5.1 National Day 84 in Riyadh, Saudi Arabia 2014:

The Kingdom of Saudi Arabia celebrated its 84th anniversary of the establishment of the Saudi state by King Abdul Aziz Al Saud in 1932, and the National Day of Saudi Arabia on September 23, 2014. The show included visual and light shows that were projected at the Ritz Carlton Hotel, in Riyadh, to illustrate the history of the Kingdom of Saudi Arabia and the achievements of His Majesty King Abdul-Aziz. (Figure 23). A team of professional designers at AO Creative created a 3D projection that was designed and prepared in 4 weeks. The show's artistic director was the lighting designer Jerry B. Applet, who designed lighting and projection content on the front of the hotel.

The show projected the past, present and future of the Kingdom of Saudi Arabia with the use of expressive music and that is through a display screen of a length of 60 meters by a width of more than 250 meters, using modern technologies.

Felix Grucci (CEO of "FireWork by **Grucci**", one of the international companies implementing the visualization in Riyadh) indicated that the performance is presented for the first time in the Kingdom, and its total duration will be about ten minutes, using (3D) technology, explaining that the number of workers in the offer reached 54 workers of different nationalities, most notably American, German, Spanish, and Saudi nationalities. He indicated that the number of devices that

will be used in the presentation is about 73 devices dedicated to the latest existing technologies. (Fifa.2014)

Figure 23, showing the front facade of the Ritz-Carlton Hotel in Riyadh and a 3D projection projection on it, 2014

5.2 Concert of singer Tamer Hosni Ali, building of the American University in Cairo, Egypt 2019:

A concert hosted by the star Tamer Hosni and the American rapper "Cilento", presented by lighting designer Walid Hariri on the largest equipped theater, designed and implemented by theater designer Tamer Fawzy, with special specifications for this technology that was presented for the first time in Egypt. The theater has witnessed many live visual effects that give the audience the feeling that they are part of a show inside a huge graphic movie. The theatrical performance lasted about 15 minutes of dazzling and visual pleasure. Al-Hariri said that he studied the making of this show over a period of 3 months at the hands of specialized artists in England, and he had to bring these experts to complete his training and education in Cairo. (Figure 24)

Figure 24, showing the artist Tamer Hosni Ali's concert of the American University in Cairo - Egypt 2019

6. RESULTS:

- The technology "3D-Projection Mapping" can convert any surface, whether it is built or a three-dimensional model, into a large video screen, and create animated picture presentations on the virtual program and display them on the surface to create an interactive visual theatrical show.

- Visual elements in the visual theatrical image allow a deeper understanding of the plastic values, and develop the awareness and conscious understanding of the language of formation within the theatrical space.
- Digital technology has been involved in contemporary theater productions in terms of preparation, design and execution. Where digital technology has developed the design stages with its innovative capabilities in theatrical lighting and light projections that have affected the shape of contemporary visual performances.
- New technology has provided the opportunity to hold huge shows in the open air and in open spaces, as well as because they attract huge numbers of spectators and require a large space to accommodate them.
- Light effects and visual media are considered an essential element for theatrical presentation techniques. They enrich the show with its effective presence and affect the success of the show in terms of clarifying the special appeal of the presented artistic image that the viewer sees.
- The contemporary trend of theater has begun to research how technology can be used and what it enables in creating new theater spaces on stage.
- It should be noted that there are not many case studies related to the 3D-Projection Mapping, due to the fact that it is a relatively new field of visual art.

7. RECOMMENDATIONS:

- Search recommends using public gathering places as places for outdoor performances, which increases the popularity of these places, as well as increasing other activities that can be integrated and overlapped with open theater performances such as shopping, tourism, competitions and others. Also Expanding the field of holding festivals and theatrical performances in open places, especially archaeological ones, due to their availability in Egypt, where they can combine two features: tourist attraction and the establishment of artistic performances with distinctive stenographic potential. And The necessity to shed light on new theatrical techniques by studying them, and paying attention to theatrical performances both internationally and locally to follow the theatrical development process.
- Theater practitioners must open themselves to the virgin worlds in the field of theater art by researching the secrets of theatrical emptiness, and enriching their own models by making use of what international cultural experiences offer. There are many places that will be opened in 2021 in Egypt, where this technology can be applied as a form of advertising and promotion.

9. CONCLUSION:

- Some distinctive trends and styles have emerged, announcing a new role for theater and new forms of performances through a renewed flexible scenography that reflects the rapid transformation of thought, culture and art, and through unlimited new capabilities and technologies.
- Digital technology has interfered with contemporary theatrical productions and developed from the design stages with the innovative possibilities it provided in theatrical lighting and light projections that affected the shape of contemporary theatrical scenography.
- 3D projection mapping technology is one of the most important technologies that create a wonderful world of still projected images and moving scenes, in addition to infinite lighting effects on any three-dimensional structure to transform it into a display space and contribute to enhancing the contemporary theatrical image, integrating multiple forms of art and eliminating differences between them so They appear in the form of an integrated and innovative artwork. This New technology has been used as an element of attraction for tourists through the creation of interactive

light performances and mixing them with the architectural heritage to highlight the aesthetic and plastic elements in the historical architecture and the cultural heritage of the city in which the show is held.

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