Research Article

Using ICT Techniques in Revive and reconstruction the destroyed parts of Al O'yoon Aqueduct Bridge

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Abstract

Abstract. Due to the destruction of some archeological/Heritage sites, as a result of the needing of establishing some national projects such as main roads and bridges that already happened on Al O'yoon Aqueduct Bridge which lost monuments and these heritage places it's civilization values and using ICT techniques and tools such as 3D Projection mapping, holograph imaging provided an appropriate restoration method that achieves the two benefits saving/reuse the monuments and heritage areas also resume using roads or bridges.

Keywords: Virtual Archeology - Virtual restoration - Information and communication technology in restoration- 3D projection mapping in reconstruction.

Research Problem: Some buildings and archaeological/heritage sites have been affected by damage caused by important and huge national projects, which distort the urban image of historical periods for example Al O'yoon Aqueduct Bridge, the difficulty lies in the possibility of restoring or revive the destruction monument and building while preserving the benefit of the national great projects that already done.

Research Hypothesis: Using of some of the ICT technologies and application will help to restore the image of historical places and resume the cultural image without affecting the benefits that come from the national great projects.

Introduction

Egypt passed through several periods and time that recorded its historical track filled with heritage buildings that had an important role and civilizational role, but with the growing population and their needs in developments such as transport, road networks and infra-structure, that affected badly on heritage places or sites such as Al O'yoon Aqueduct Bridge that negatively affected the impact and its image Cultural and historical and neglected its history, which shuffled and reduced the historical picture of the period represented by the impact, but the development in the use of information technology and communications Information Technology and various applications will help in the restoration of the image that had an impact and restore some of the Its historical and heritage value.

(1) Historical Introduction to the Al O'yoon Aqueduct Bridge (El-broumbqlly,2008)

The Al O'yoon Aqueduct Bridge was built in 1176 AD and was completed in 1508 AD by sultan Al-Ghouri, it is an extension of the Salah El-din's wall, it called The

Al O'yoon Aqueduct Bridge was built in 1176 AD and was completed in 1508 AD by sultan Al-Ghouri, it is an extension of the Salah El-din's wall, it called "The canal of the eye" because it is a channel of water above ground and has eye-like openings.

This wall has been operating since the construction of the fence until 1872 AD and stopped working after the establishment of the "Cairo water Distribution Company" (2008 ،البرمبلي) .

Fig.1 Shows old images for Al O'yoon Aqueduct Bridge

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(2) Architectural Description of the Al O'yoon Aqueduct Bridge

The O'yoon Aqueduct bridge extends from "fom El Khalig" through Salah salem road to the "saieda Aisha Mosque" area, it was used to transport water from the area of form el khalig and then to water way to reach the castle and it consists of three main parts:

A. Tower of getting water

It is a tower consists of 3 floors (ground and two upper floors) there are 6 waterways that moving by bulls to pump water to above the bridge and then take its way to castle, this distance is 2.2 km, the height of its rising decreases to reach 3 m in some places.
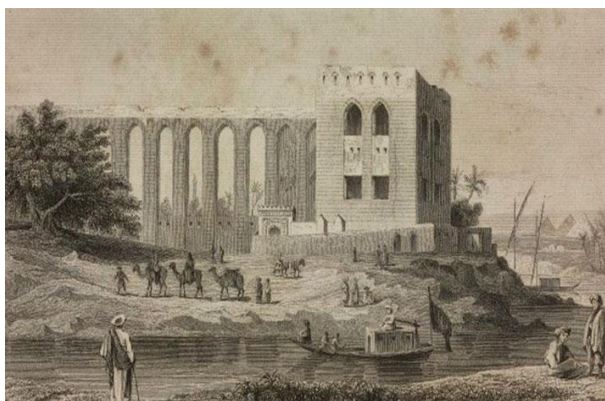

Fig.2

Fig.3

B. The arches fence

That the fence which water runs over its surface, and it consists about 230 arches with different heights which decreasing till get the castle (p, 1991)

C. Salah El-din Fence

It is a part of Al O'yoon bridge which deliver water to the castle

Fig. 4 shows the body of the bridge which consist of about 230 arches

(3) Definition of Virtual Archeology

Virtual Archeology is a term introduced in 1990 by the archeologist and computer scientist "Paul Reilly"[1] to describe the use of computer-based simulations of archaeological excavations and since that date scientific results related to virtual archeology were annually discussed, among others, at computer applications and quantitative methods in archaeology.

- **in London charter Initiative** 2009 the focus of the term has been extended, and today it serves as an integration paradigm that allows many modern three-dimensional datasets to be analyzed together, taking account preliminary reconstructions of archaeological sites and guiding further investigations. (1991,Daeun Lee)

(4) Using (3D Projection mapping – 3D holography) in reconstruction and revive Al O'yoon Aqueduct Bridge's area

3D Projection mapping:

- It is defined by 3D Projection mapping, Spatialized Projection Mapping, also known as Spatialized Augmented Reality.
- Physical three-dimensional Projection mapping involved Projecting images/videos Using "lights" and other augmented objects on the physical environment with "digital Imagery"
- The differences between projection on screens specifically by examine the effect of the other Variables such as effects of sounds and other contents and involve the 3D dimensional object
- Projection mapping presents the virtual layer directly onto the physical object.(2017,Soyoung Jung)
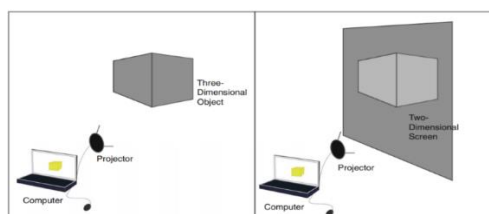

Fig. 5 Shows the Different of projecting on 2D surface or Screens and Spatialized 3D augmented

Reality projection mapping onto 3D object

- Also, projection mapping mean merging of virtual information and 3D physical objects without a head-mounted display HMD or smart phones displays, the key difference between this medium and single user augmented reality interface is the multiple-user experience since it projects an image on the physical object directly.

History of Projection mapping

- The Projection mapping technique dates to the late of 1990 where it was referred to as video mapping, spatial augmented reality, or shader lamps.
- The first public use of projection mapping was in 1969 when Disneyland opened their haunted mansion ride, which featured singing busts.

Projection mapping Method

Is by analyzing the 3D Form to its edges, polygons, and vertices and re simulate it by 3D software's to re-project it by 3D projected mapping's techniques.

Projected mapping Tools are:

- Computer to simulate or analyze 3d forms.
- Projectors to project data on 3d objects.
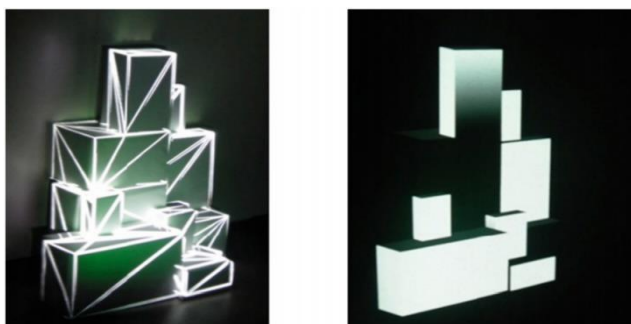- Three-dimensional object to receive data on.

Fig. 6 showing the simulation of 3d form to edges, polygons and vertices

Digital Data Pump & Fiver-Fed Media Servers (DDP) – (Laservision Company)

It is the latest generation of multimedia server till Dec.2018, it is delivers levels of integration and performance for use a multi-media spectacular, also it constitutes a mass control system, and it is used in conjunction with Fiber-fed media servers to facilitate the precise control and distribute a massive volume of data across performance arena for the city scale spectacular.

Also, DDP provides seamless integration of performance media including laser, lighting, pyrotechnics, water screens, fountains, HD videos professional quality audio and more.

There is many software's using to make a 3D projection mapping such as Adobe after effect, but the "Media Manager" software is a laser vision's flagship software for computer-based media production**. That combining elements of data management, timeline, editing, real-time preview and rehearsal and on-demand playback triggering, the application suite brings together to complete management capability for ten different media types under a single unified interface.** (Wikipedia,2018)

Together with the Digital Data Pump Series III, Media Manager provides the ultimate professional tool for creating, sequencing, replaying and triggering multi-media events of any scale.

Fig. 1 Digital Data Pump & Fiber-Fed Media Services Server

Lighting of Historical Facade types

Lighting of historical Facades is a tool to enhance the function of the historical facades and give it a usable function. (Moghaddam, 2014)
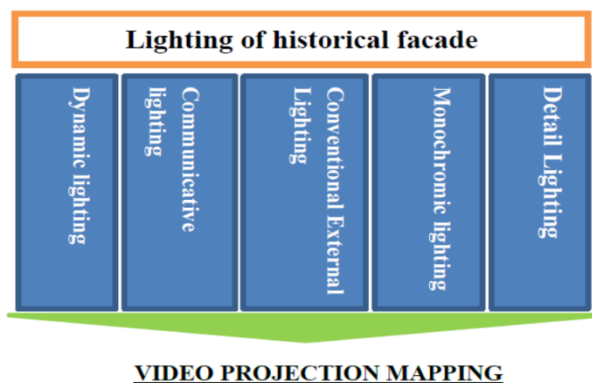

Fig. 2 shows the lighting of historical facade types by projection mapping

Detailing lighting

Detail lighting focused on architecture, and materials being used in the buildings and the lighting effects.

The elements of façade are highlighted and there is an emphasis on its natural structures, small lighting appliances are fixed onto the façade to light certain details. (services, 2007)

Fig. 3 Examples for Detailing Lighting of historical Buildings

Also, Detailing Lighting Can be Classified to:

- Spotlight.
- Extended lighting.
- Outdoor linear lighting. (Bordonaro, (2006))

Fig. 4 Show Examples for Spot lighting, Extended Lighting and Outdoor linear Lighting.

Conventional external lighting

Using a large amount of light that can be produced in conventional external lighting, that make a light distribution on façade, lighting projector should be placed far from the building to make the architecture details and features appear as they look like in daylight (moghaddam, 2014).

Fig. 5 example for Conventional lighting for historical building

Communicative lighting

This kind of lighting not only highlighted but also appearing some kind of information that give opportunity to present massage and information in the form of texts, animations or images.

Dynamic Lighting

Making dynamic colored light, patterns, or images. Uses of this type of lighting are limited to special events and occasions and on the buildings, which are not ornamented and look plain.

This Tanique made a dynamic lighting especially for City landmarks, such as Eiffel tower in Paris on its 120 [th] YEARS IN 2009, That 400 LED RGB luminaries were installed on the Eiffel tower giving a memorable light show.

The dynamic lighting method/Tanique gave many possibilities of 17-minute light shows displayed 4 times each evening for 10 days period. (CIE, 2008)
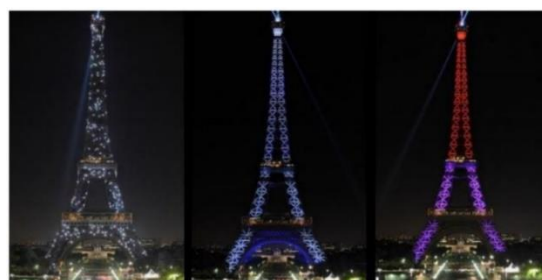

Fig. 6 Example of Dynamic lighting on Eiffel tower

Significance of light on Historical Building

Lighting on historical buildings seems to be more significant compared other public spaces that can serve the following objects:

(1) Creating a highlight on historical buildings
(2) Creating a harmony between meaning and identity of the place.
(3) Attracts and invites the audience to the place or the historical building. (Kutu, 2012)
(4) Promoting the quality of observation of the certain site especially at night.
(5) Adding a variable face to the historical buildings which enhance the historical and social values of the building.
(6) Contributing to the economy by promoting night use of historical places.
(7) Make a virtual reconstruction for a historical facade.

Virtual Reconstruction Method and guidelines:
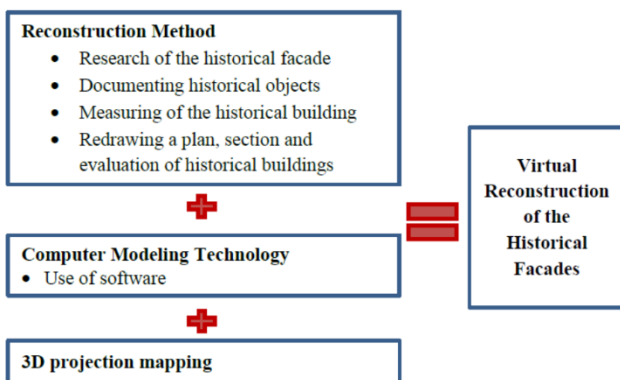
Fig. 13 showing the steps of 3D Projection mapping method

Research of a historical façade and heritage area

use tools to document the historical sites, buildings and its surroundings as a contour line and building dimension can simulate a 3D projection to re-project it on the specific faces. (Moghaddam, 2014)

Fig. 14 Measurement tools to Document the historical Building/Area to make a projection mapping

**Tools& Devices used to make a 3D Projection mapping:**

(1) Short throw HD Projection.
(2) Motion Sensor
(3) Terminal video mapping (stores the information and commands)
(4) Speakers (Hank, 2002)
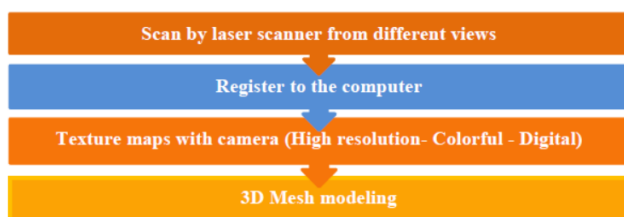(5) Interaction zones
(6) Users
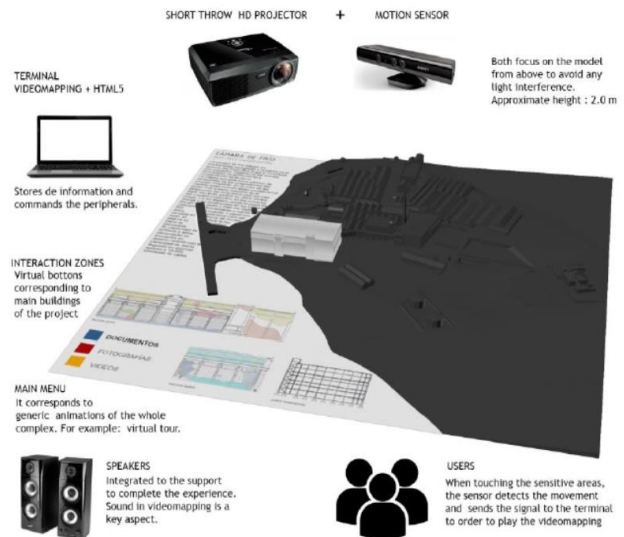
Fig. 7 shows tools used to make a 3D Projection mapping

Computer modeling technology by two methods:

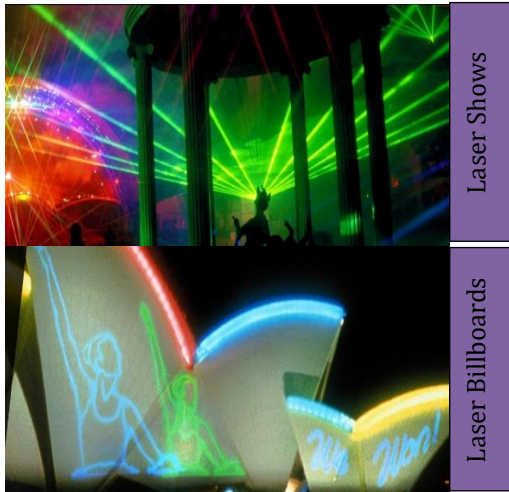**1. Semi-Automatic-Image based on modeling Conclusions.** (Zhang, 2005)
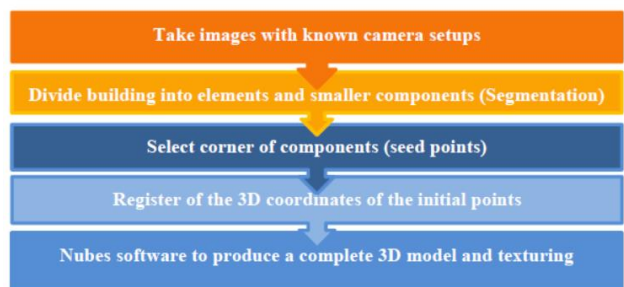
2. Mesh Modeling from 3D-images (Zhang, 2005)

Can Use projection mapping with DDP in:

(1) Laser Shows
(2) Laser Tunnels
(3) Laser Billboards
(4) Architectural & Show Lighting

(5) Projection mapping and Video Projection
(6) Water Screens
(7) Water Fountains
(8) Pyrotechnics
(9) Fire FX
(10)   Special FX (Zhang, 2005)

Laser Shows

Laser Billboards

Architectural & Show Lighting

- The use of theatrical and architectural lighting is often the fundamental part of a modern spectacular, special event, or permanent installation.
- Architectural Lighting design has become even more sophisticated both in effects and the level of programming required.
- One of Laser vision's most notable (laservision, 2018)

Holography

Definition of Holography:

Is the process of capturing three-dimensional images by recording patterns of light wave reflection. These recorded holograms are viewed by re-exposing the developed film to light to recreate the pattern of light recorded.
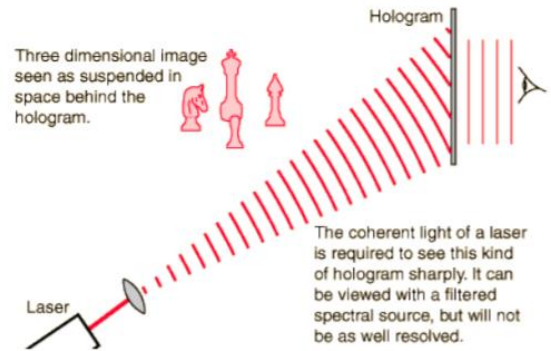

Fig. 8 showing a holograph object

History of Holography

Holography was first developed by "Dennis Gabor" – British scientist in 1947, and he received the Nobel prize for his work in 1970
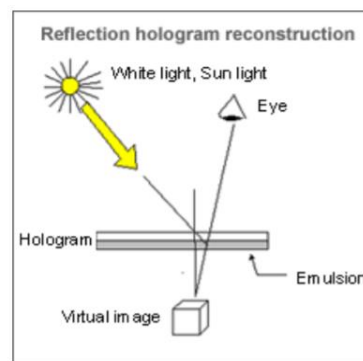Hologram Types

(1) Transmission holograms:

Use laser and light source through the hologram towards the observer.

(2) Reflection holograms:

use a light source (white light) from the same side as the viewer. (https://en.wikipedia.org, 2018)

Fig. 9 Reflected Holograms

(1) Embossed holograms:

Are the ones you typically see on credit cards the interference pattern is recorded onto a metal stamp and then imprinted on cheap foil.
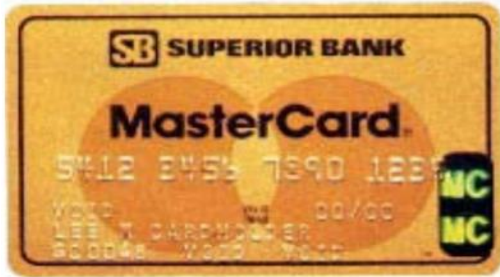

Fig. 10 shows a credit card as an example for embossed holograms

(3) Computer holograms.

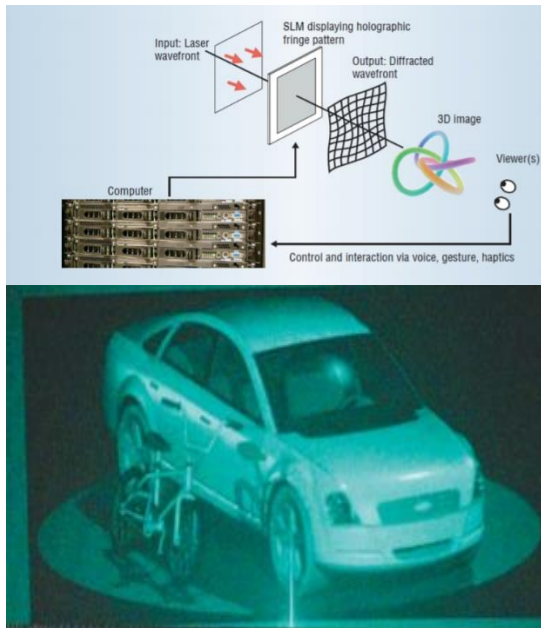Using mathematical models, the interference pattern on the hologram is calculated by a computer.

Fig. 20 shows the steps for computer holograms

(4) Holograms

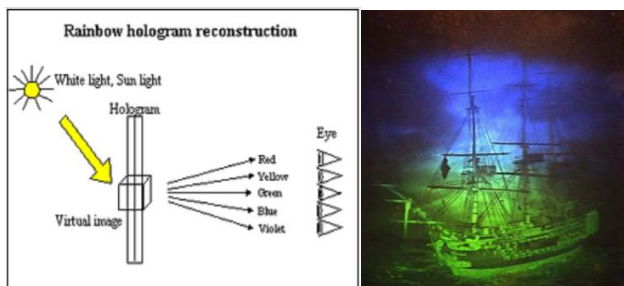The same image appears in different colors when viewed at different angles.

Fig. 11 Rainbow hologram

Projection mapping types which selected on Al O'yoon Aqueduct Bridge facades:

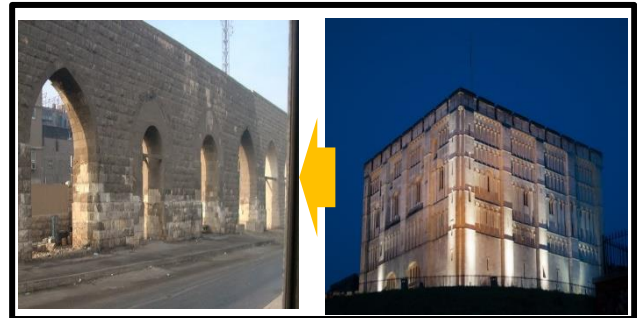- **Using Detailing lighting to enhance the architectural elements on Al O'yoon Aqueduct Bridge**

Fig. 12 Using Detailing lighting to focus or highlighting architecture elements on Al O'yoon Aqueduct Bridge

- **Using Linear lighting on linear straight walls or details on Al O'yoon Aqueduct Bridge**

Fig. 13 using linear lighting to enhance the image of the bridge

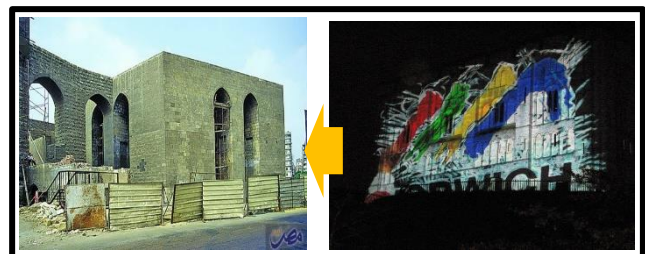- **Using Dynamic Lighting on flat walls such as the tower's walls**

**Fig. 14** using Dynamic lighting on straight walls of the bridge

- **Detecting some spaces surround the bridge to be places which project digital data from:**

There are different spaces that can place servers or switches on, that to project digital data which simulate by 3D projection mapping method, or also can use it to make a reflected holographic
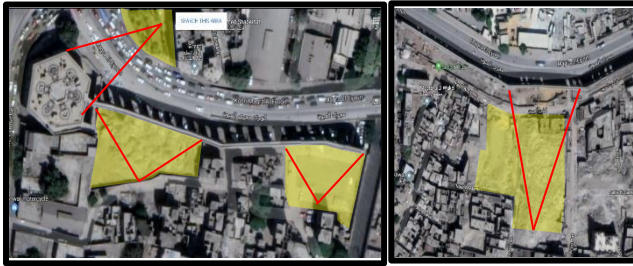
Fig. 15 shows different spaces which can place projectors on to project digital data on the bridge building

- **Using Holography technique to reconstruct elements on bridge and can also using wired mesh modeling to be permanent reconstructed.**
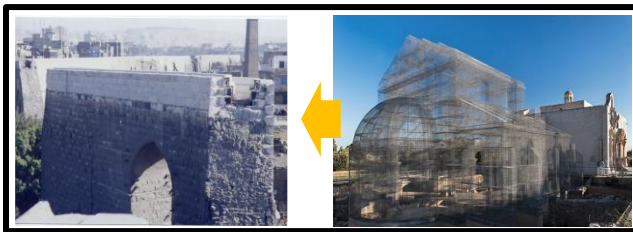
Fig. 16 Using Holography mesh modeling to reconstruct spaces on the bridge

Conclusion

- Information communication technology Provide tools such as 3D projection mapping, Holograph imaging to reconstruct or revive the heritage places as the Al O'yoon Aqueduct Bridge and also enhance the surrounding areas of it.
- Using ICT techniques helps to restore the historical area and buildings and resume the image of culture for this period.

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