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Reviving the Ruins of Berenice in the Sidi Khrebish Area of Benghazi Old City by Using Holographic Technology

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ABSTRACT

The city of Benghazi contains rich archaeological and historical monuments that form the spirit of the city, its civilization, and its ancient history, which needs to be preserved and revived in order to preserve the cultural and historical heritage of the city and its buildings and sites. Sometimes preservation involves many different aspects, such as celebrating events, people, places, and ideas that we are proud of. It also sometimes involves recognizing moments in our history that can be painful or uncomfortable to remember. Sidi Khreibish is an archaeological area of important historical value for the Old City of Benghazi in particular and for the city of Benghazi in general. Through the lighthouse, which constitutes the main landmark, it needs to be revived and presented again. With the technical development in the use of technology in architecture, especially in virtual reality and simulation applications, it has become possible to create a virtual environment using technology to reformulate the architectural and urban heritage. This is done by illusioning the recipient's eye with non-existent 3D models or surfaces that are shaped in a vacuum using advanced hologram techniques and presenting it as a default model. The current study included an integrated analysis of the study area and how the holographic imaging technique could be used, which has a unique feature that enables it to recreate the image of the original objects in its three dimensions to a very high degree, in order to re-embody the Old City and highlight its features of great historical value for the region and revive it within the fabric of the urban city.

KEYWORDS: Benghazi city, Sidi Khreibish, Berenice, Holographic Technology.

1. INTRODUCTION

1.1 overview

The city of Benghazi is located in eastern Libya. The city's history is characterized by its successive civilizations, and its distinctive urban mix reflects its historical and cultural significance over time. Old Benghazi, the so-called "Berniki" (Sidi Khrebesh), is the second city after Hesperides (Sidi Obeid) and represents the first nucleus of the city's genesis and urban growth. In addition, Sidi Khrebesh is a very important archaeological area in terms of its scarcity, but almost since its disappearance it has lost significance to the city, and Benghazi Lighthouse is an important landmark and a true masterpiece in architectural heritage. They blended Ottoman and Italian influences to create a unique and distinctive structure. Its rich history and cultural significance also make it an important landmark for the people of Benghazi, where it stands as a symbol of strength and resilience in the face of adversity.

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Unfortunately, historical monuments and buildings are neglected and disappear without restoration or attention. The city's history is the most important part of the identity of the city that its people are proud of. This requires action to be properly documented and presented, reflecting the importance of the city and its long history. Trying to study these monuments in Benghazi is of great importance as a first step to highlight their importance, to highlight historical sites, and to revive them through the use of modern technology and means.

1.2 Significance of the study

The city of Benghazi has a rich history, yet its ancient monuments and historical buildings face neglect and are disappearing without restoration or care. Studying these monuments in Benghazi is a crucial first step to highlight their significance, showcase historical sites, and revive them using modern technology and methods. The city's history is an essential part of its identity, which is proudly cherished by its residents. Therefore, it must be documented and presented in a manner befitting the city's stature.

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1.3 Aim of the study

The aim of the study is to understand and protect Khrebish historical and archaeological sites in order to conserve their cultural and historical significance for future generations by reviving the ruins of Berenice by using holographic technology.

1.4 Scope and objectives of the study

The scope of the study is the walls surrounding the archaeological site of the city of Berenice in the Sidi Khrebish area, including the lighthouse building, an attempt to create a new perception of the area that includes re-landscaping after studying the movement within the site, highlighting its historical importance as a vision for the future city of Benghazi.

1.5 Methodology

The research relied on the descriptive method, which addresses scientific studies related to the research topic. Regarding the study site, the research primarily focused on the manuscripts extracted from the archaeological sites in the Sidi Khrebish area. Since the studied region has witnessed multiple civilizations in the same location, digital methods offer greater flexibility in representing this era in a manner close to reality without compromising the integrity of the artifacts. This aspect was explored in the context of holographic technology and its applications. Additionally, the analytical method was employed to analyze the study site from several key perspectives.

2. LITERATURE REVIEW

The preservation of ruins is a global movement that considers human-made environmental history as an important part of human heritage that is worthy of preservation. One of the main issues in preserving ruins is the lack of available funding to protect and maintain them. Sites managed by government bodies face difficulties in maintaining the location, let alone stabilizing and protecting it. Another issue threatening the survival of ruins is the risk of development and new construction. Often, these sites are demolished and new homes are built on the foundations. Ensuring the preservation of ruins for future generations is crucial in educating people about the past. Ruins serve as a reminder of the construction practices used by previous generations. They not only offer stunning views but also act as educational tools. When a building disappears, the best alternative is what remains of the ruins [1].

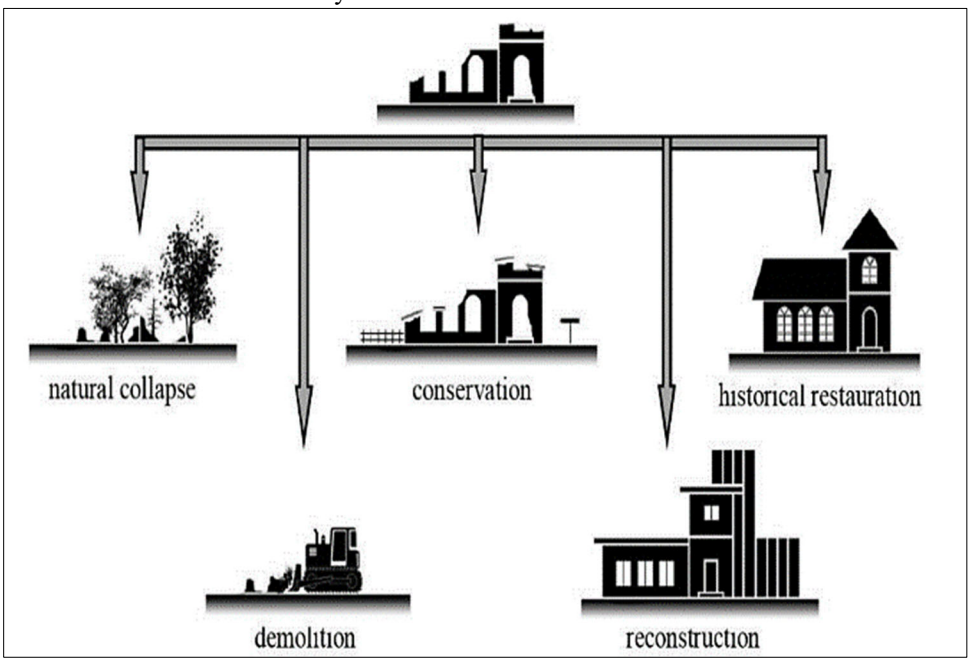


Figure 1: Scenarios of development of ruins.

2.1 General overview of ruins preservation

The preservation of ancient historical sites requires a balance between stabilization and restoration; while full restoration can enhance the external appearance, it is costly and may diminish the authenticity of the ruins. This approach seeks to strike a balance, similar to the reinforced layers in digital history applications. The demarcation of the Roman Empire's boundaries in what is now known as England is exemplified by Hadrian's Wall, which dates back to the 1st century AD. This structure extends 73 miles, punctuated by small forts, watchtowers, and garrisons, and it served as an active military site for 300 years. Milecastle 39, also known as Castle Nick, is

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one of the most prominent remaining stone structures of the wall [2].



Figure 2: Milecastle 39.

Holography Technology

There are many modern techniques used in the field of restoration and preservation of antiquities, and they depend on advanced natural sciences and modern tools and equipment. Some of these techniques include the following:

- Virtual modeling and virtual reality: the use of hologram technology so that lasers are used to create three-dimensional images that look like real ones and are used in various fields, especially in the field of architecture and design.
- Using lasers to remove dirt, deposits, and unwanted coatings from stone, metal, wood, and paper surfaces.
- The use of ultrasound to examine cracks and damage in archaeological materials without causing damage to them.
- Using infrared, ultraviolet, and X-ray imaging to detect hidden or counterfeit layers in paintings, manuscripts, and coins.
- The use of chemical and spectral analysis to determine the composition, history, and source of archaeological materials, as well as to detect any added or contaminated materials.

Despite the contribution of these modern technologies used in the field of restoration and preservation and the protection of cultural and archaeological heritage from damage and loss. However, it requires high expertise and respect for the original material of antiquities and is not replaced by traditional techniques except when necessary [3].

Definition of Hologram

A hologram is a three-dimensional light field produced through the physical recording of an interference pattern. This pattern involves diffraction, which ultimately creates a virtual 3D image of the original scene.

In simpler terms, holograms are 3D images formed by the interference of light beams reflecting off real, tangible objects. Unlike typical 3D projections, holograms can be viewed with the naked eye without the need for 3D glasses.

The process of creating holograms is known as holography. While the technology has not yet reached the level of cinematic magic, it can produce holograms that capture the depth, parallax, and other characteristics of a real scene. [4]. Holograms can be used to show buildings clearly and attractively and to improve communication between designers, customers, and users. Some of the hologram policies in showing buildings are as follows:

- Using holograms to show historical or archaeological buildings so that the visitor or tourist can see how the building was in the past and learn about its history and culture.
- Using holograms to show buildings before they are built so that the client or user can see how the building will look in reality and provide feedback or changes to the design.
- The use of holograms to show futuristic or imaginary buildings so that the artist or designer can create new and unusual scenes and challenge the boundaries between reality and imagination [3]..;.l'

Development History of Holographic Projection Technology

Emerging Stage: In 1947, British physicist Dennis Gabor first proposed the concept of holographic imaging while studying microscopes. The idea of holographic projection gradually began to emerge before the public.

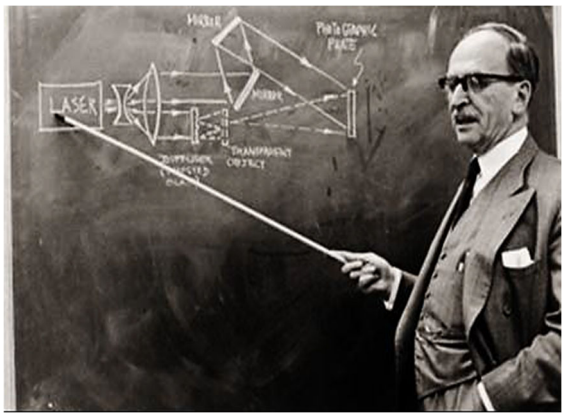


Figure 3: Denis Gabor 1975.

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Exploration Stage: In 1960, the invention of the laser solved the problem of the lack of technology necessary for holographic projection, as the technology reached a certain level of development during this period. In 1962, Soviet scientist Yuri Denisuk captured the first direct optical holographic projection image, capable of recording three-dimensional objects. Leith and Upatniks, staff members of the Radar Laboratory at the University of Michigan, applied the theory of "side view radar" used in the communications industry to holographic imaging based on virtual imaging technology. They discovered off-axis holographic technology, which took virtual imaging to a new level and significantly improved projection performance. In 1969, Benton discovered rainbow holography, which increased the demand for light sources in holographic projection technology.

Bottleneck Stage: In the 1970s and 1980s, holographic projection technology dominated the fields of great interest to scientists at that time. However, most holographic imaging technologies were in the stage of development and consolidation, resulting in few breakthroughs during this period.

Development Stage: With the onset of the 21st century and the rapid advancement of information and material technology, holographic imaging techniques became increasingly diverse. Holographic film technology was developed in 2001, and in 2006, 360-degree ghost imaging technology was widely applied; in 2008, a 3D holographic display screen was developed; in 2014, a 3D holographic projection chip was successfully developed; and in 2017, a 3D imaging fan was developed and put into use [5].

How Does Hologram Work?

Holography consists of capturing a light field and subsequently reconstructing it without the original objects present. This process can be likened to sound recording, where the sound generated by a vibrating object is processed in such a way that it can be reproduced later (even when the original vibrating object is not there). To create a hologram, three essential components are required:

- A laser beam directed at the object.
- A recording medium containing the suitable materials.
- A clear environment that allows for the intersection of the light beam. [4].

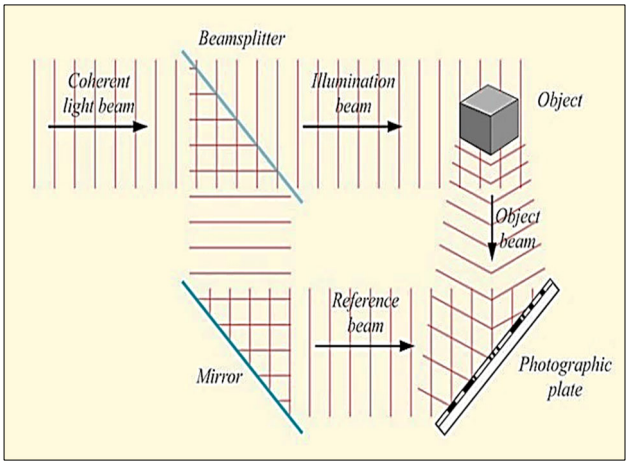


Figure 4: Recording a hologram.

Essential Components for Creating a 3D Hologram:

- **Laser Device**: Produces an argon laser beam or a helium-neon laser that emits red light.
- **Lenses**: Used to focus and direct the laser beams onto the object or imaging plate.
- **Light Splitters**: semi-reflective mirrors that divide the laser beam into two separate parts.
- **Reflecting Mirrors**: Guide the laser beams through the lenses and split the light at designated positions.
- **Hologram Film**: Composed of a layer of photosensitive materials applied to a light-permeable surface, such as a plate of lithium liquid crystals or photopolymers, which are utilized to record the hologram.

How to Obtain a 3D Hologram

To create a three-dimensional stereogram, an object must be present to serve as the target for imaging. Additionally, a laser source is needed to project the beam onto the object that is to be photographed. A recording medium is also required to capture the scattered rays from the object through semi-reflective mirrors, which divide the laser beam into two identical beams. One beam is aimed at the object, reflecting off it onto the recording medium, while the other beam is directed straight to the recording medium to produce the primary stereo image through the hologram.

The hologram (the plate or the recorded interference pattern) contains a complex arrangement of transparent and dark regions. When a light beam similar to the original reference beam is directed at it, the beam passes through the transparent regions while being absorbed by the dark areas to varying degrees. This process generates a composite wave that resembles the original object, creating a similar image in space.

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Thus, obtaining the hologram occurs in two stages: first, where the interference patterns of the light rays are recorded to form the hologram; and second, where the hologram is illuminated in a specific manner so that the incoming beam matches the object wave, resulting in an image that appears as the original object [6].

Principle of Projection Reflection Imaging

Pyramid Holographic Projection

Pyramid holographic projection imaging is generally based on the principle of light reflection, where light signals are reflected onto prisms inside the pyramid-shaped structure. When light encounters the boundary between two different media, it reflects without undergoing refraction. As light passes from a denser medium to a less dense one, the angle of refraction becomes larger than the angle of incidence. If the angle of incidence increases enough, the refracted angle eventually reaches 90 degrees [7].

When these optical signals are combined, they create a spatial configuration resembling the image of a virtual object, as depicted in Figure [5].

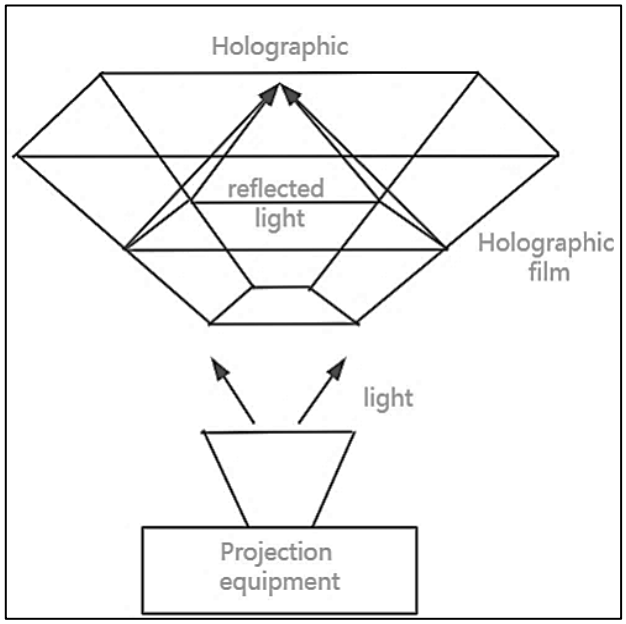


Figure 5: Pyramid holographic projection.

Holographic Film Projection

From the standpoint of imaging principles, holographic film projection enables viewers to see the scenery behind the film while providing sharp image clarity. The quality of the image is exceptionally bright and clear, achieving an impressively ultra-thin form. This projection technique produces a crystal-clear visual experience that immediately captures the audience's curiosity and attention, delivering high-quality visual information without obstructing the presentation of physical exhibits. Unlike three-dimensional imaging using pyramids, holographic film projection is not constrained by venue or design, allowing for widespread creativity and distribution. This flexibility fosters inspiration, imagination, and a sense of technological innovation throughout the environment [8].

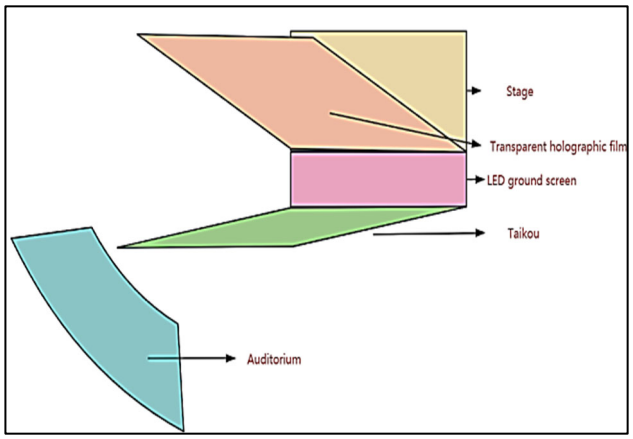


Figure 6: Holographic Film Projection.

Characteristics and Applications of Virtual Holographic Projection

2.2.4.1 Single-Chip Penetration Screen

The single-chip penetration screen is a notable feature of holographic projection. Its precise internal optical structure effectively filters and reduces surrounding light, resulting in exceptionally clear images, particularly with bright picture quality. Additionally, the single-chip screen is remarkably lightweight, which is another distinguishing characteristic.

2.2.4.2 High Transparency

High transparency is another key feature of holographic projection. Unlike traditional projection methods, holography exhibits high brightness and contrast, enabling image quality that exceeds HD standards. Furthermore, it allows for dual-sided imaging, accommodating various objects and presenting them from different angles, even under typical environmental conditions.

2.2.4.3 Simultaneous Presentation of Real Scenes and Images

A unique aspect of holographic projection is its ability to display both real scenes and images simultaneously. This means that it can not only present the content of the actual scene but also integrate images with it, offering a range of aesthetic possibilities. This includes various transparency options, allowing effects such as transparency, translucency, and opacity.

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2.2.4.4 Considerations for Cultural Exhibition Halls

Cultural exhibition halls are typically indoors and require effective light and shadow to enhance the display. Similarly, outdoor exhibitions also depend on light and shadow, often presented in a way that mimics the effects of window displays, akin to shop window advertisements. While external light intensity may fluctuate, holographic projection remains unaffected by these variations. [9].

Advantages of Holographic Projection Technology

- **Novel Form:** Unlike traditional 3D display technologies, holographic images do not necessitate specialized viewing equipment; they can be seen with the naked eye, providing very realistic 3D display effects.
- **Highly Technical:** This technology involves integrating multiple advanced techniques. In practice, it combines various technologies, such as sensing, touch, and voice control, to achieve an optimal blend of visual effects and interactive experiences.
- **Flexible Size:** Holographic projection offers excellent imaging quality, with customizable imaging areas tailored to customer requirements, ranging from a minimum of 20-30 centimeters to over 40 meters. This adaptability makes it suitable for diverse industries and clients, ensuring the best holographic image display for various products.
- **Strong Interactivity:** The display design employs holographic projection technology to turn static objects into dynamic ones, shifting from one-sided displays to interactive experiences for the audience [5].

Applications

As society begins to adopt increasingly advanced technologies, holography has the potential to fundamentally change our perception and experience of architecture. While it's challenging to predict the exact future applications of holographic technology, several existing projects illustrate how holograms and various forms of holography are being utilized to create immersive environments, imaginative scenes, and practical visualizations. These examples go beyond simply using holograms to visualize designs and structures; they employ holography to influence the actual architectural space, significantly transforming the sensory and spatial experience of the environment [10].

2.2.5.1 Ruins as a tourist attraction point:

Heathen's Gate:

At one of Austria's renowned historical sites, a simple line drawing overlaid on a pane of glass breathes life into the crumbling ruins, reanimating the partial building near the Open-Air Museum Petronell. When a viewer aligns the illustration with the structure known as Heidentor (Heathen's Gate), the image compellingly completes itself in an entirely low-tech manner. Located just east of Vienna, Carnuntum dates back to the 1st century A.D., when Roman soldiers expanded an existing town of 50,000 people to establish a military encampment. Between 354 and 361 A.D., a significant triumphal monument was built next to the military camp and city, which was commissioned by Emperor Constantius II, as historical records indicate, to honor his victories. [11].



Figure 7: Heidentor's gate.

Multimedia Light Shows Reviving Ancient Rome at Night:

The Viaggi nei Fori project animates the history of ancient Rome with a multimedia display cast onto the ruins of the Forum of Augustus and the Forum of Caesar. This event runs every evening from June 10 to October 2, 2022. Developed by Piero Angela and Paco Lanciano, the show utilizes light, images, film, and animation to depict life in ancient Rome, with viewers observing from elevated seats along Via dei Fori Imperiali. The presentations build upon the existing marble columns and ruins, employing advanced technology to recreate the forum areas as they appeared during imperial times [12].



Figure 8: 2022 Timetable Forum of Augustus.

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3. SIDI KHREIBISH SITE

Old Benghazi, or what is called "Berniki" (Sidi Khreibish), is the second city after the Hesperides (Sidi Abeed), the first nucleus of settlement. The sources indicate that the wife of Ptolemy III moved her old location in Eusperides to Berenice at the sea. Sidi Akhribish is a neighborhood located in the center of the city of Benghazi. It is bordered to the east by the Al-Sabri neighborhood, to the west by the center of the city, and to the south by the Al-Funduq Al-Baladi Hotel and Al-Jarid Market. This neighborhood was built on the ruins of the city of Berniki, and the area still contains a group of antiquities dating back to that period and its aftermath. There are several old streets branching out within the area formerly known as Torelli, for example, Balah Street, Al-Baja Street, Kweri Street, Sidi Bou Said Street, and Bougoula Street. The neighborhood includes an archaeological area [13].

The area still contains a group of antiquities dating back to that period and its aftermath, despite the theft of many of them [14]. The lighthouse of Sidi Khreibish is located in the neighborhood, which is considered a landmark of the city of Benghazi, on a high hill overlooking the seashore close to the port, as it was established in 1935 AD in the highest area of the city, which is the current cemetery of Sidi Khreibish, which is built over the site of the "Acropos" castle, the Ptolemaic city of Berenice, which was established around 247 B.C.E.

3.1 Brief historical background

Although the site of Benghazi had "been occupied since ancient times, the development of the centre remained slow and erratic until the early decades of this century. The centre was almost certainly founded by Greek settlers from the Jebel at some time before 515 B.C. However, no certain reasons are yet known for the establishment of what was then known as Eusperides, replaced by Berenice. In the third century B.C., the city was renamed in honor of the wife of the Egyptian King Ptolomy III. Eusperides had direct sea communications, and perhaps its effective defensive site developed serious defects because of the gradual silting up of the lagoon on which it was founded. The transfer from the old site was, therefore, inevitable [15].

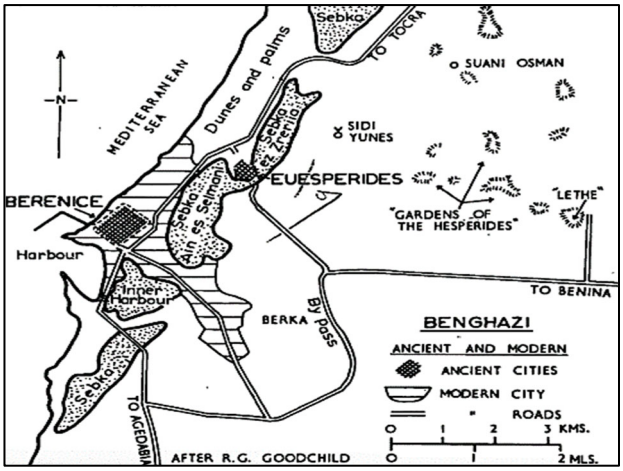


Figure 9: Benghazi: ancient and modern.

Occasional discoveries of mosaic floors and other artifacts confirm the location of Berenice beneath Benghazi and its associated cemeteries. Excavations conducted between 1971 and 1974 in the old Turkish cemetery of Sidi Khrebiesh uncovered remnants of buildings and pottery dating from the Hellenistic period to Byzantine times, along with a section of a late town wall. A stele from the 1st century B.C., discovered in 1972-73, documents civil unrest and pirate attacks. Inscriptions of the 1st century A.D., found previously, mention the separate magistrates of the Jewish community and a synagogue. [16]

Near Benghazi are several sites of legendary interest. The Hesperides, known for their golden apples, were believed to inhabit a lush, sunken garden associated with several natural depressions in the plain located about 10 kilometers east of Benghazi, providing a plausible setting. One of them has an underground pool, which possibly accounts for the location of the river Lethe there. [16]

Benghazi Lighthouse:

In 1992, the architect "Veraza" prepared the design of the water tank and the lighthouse in a classic style derived from architecture in the Islamic era, and its exterior shape is largely the minaret of the Kairouan Mosque in Tunisia." [17]. It contains two tanks, one to supply the city with drinking water, and the second is a tank used to clean the sewage network by supplying it with sea water and then re-pumping it.

The lighthouse is 41 meters high, and it lights up with a white light in a circular pattern every three seconds. A water tank is crowned at the top of the lighthouse lamp, which is located on the upper two floors. Its light can be seen from a distance of 17 nautical miles. [17]. The lighthouse building remained as it was, with its main function being a landmark that expresses the city of Benghazi. Recently, terraces have been added as an

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integral part of the lighthouse design, directing it towards the Mediterranean.



Figure 10: Building the Lighthouse.

3.2 Site analysis

Site analysis refers to the process of studying the physical characteristics and environmental conditions of a site where a proposed building or structure is to be constructed. This analysis is crucial for architects to understand the site's attributes and limitations, including the landscape, topography, orientation, natural or man-made features, availability of utilities, and various other factors that could affect the design and positioning of a building. Site analysis helps architects to develop designs that are harmonious with the surrounding environment and meet the client's needs while considering the site's unique characteristics.

3.2.1 Sidi Akhribish neighborhood

Sidi Akhribish is a neighborhood located in the center of the city of Benghazi. It is bordered to the east by Al-Sabri neighborhood, to the west by the center of the country, and to the south by the Al-Funduq Al-Baladi Hotel and Al-Jarid Market. This neighborhood was built on the ruins of the city of Berenice, and the area still contains a group of antiquities dating back to that period and its aftermath. There are several old streets branching out within the area formerly known as Al-Torelli, including, for example, Bala Street, Al-Baja Street, Kweri Street, Sayed Busaid Street, and Bougoula Street.

3.2.2 Site attributes

The archaeological area is fenced and has two entrances. The antiquities are scattered and not visible from behind the walls. The movement inside is not clear and neglected. There are few modern buildings inside, and they are destroyed. The area still contains a group of antiquities dating back to that period and its aftermath, despite the theft of many of them. The Lighthouse of Sidi Khreibish, which is considered a landmark of the city of Benghazi, is located in the neighborhood on a high hill overlooking the seashore and close to the port.

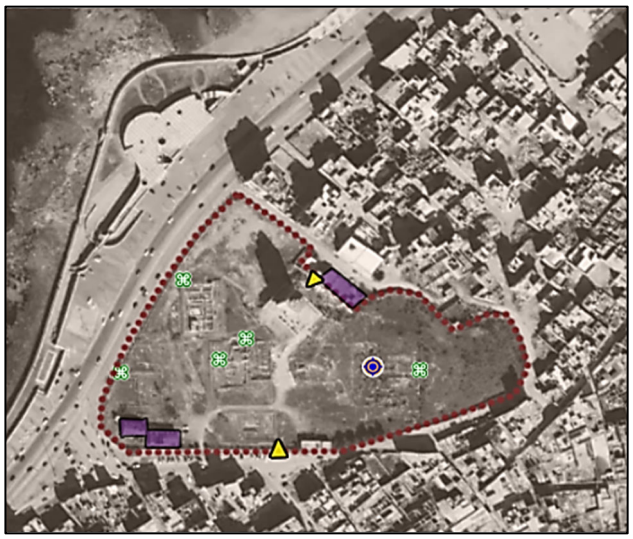


Figure 11: site plan.

3.2.3 Visual axis

The site is located on a hill, which helps to allow passersby to see, despite the presence of a wall surrounding the site. The field of vision is narrow in the residential neighborhood on the southern and eastern side, while on the seaside there is a wide field of vision. The Lighthouse block is elevated relative to the surrounding buildings. It is considered an important visual attraction in the region, as it also represents the identity of the city.

3.2.4 Skyline and waterfront

Iconic structures that serve as landmarks and symbols of a city. The city's blend of different architectural styles creates a visually captivating and diverse urban landscape. Benghazi city skyline can be seen, and architectural elements are identified as basic elements in the skyline. Where the lighthouse occupies a key element in shaping the waterfront skyline of Benghazi. Other elements include bringing the Benghazi Cathedral and other minarets to life by recreating them in a realistic and interactive manner. Holographic scenes allow viewers to see and engage with the past in an engaging and dynamic way.

3.2.5 Study of Sidi khirebish excavations

Until recently, Berenice was one of the least known of ancient Cyrenaican cities. Most of the site is covered by

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modern Benghazi, whose buildings employed (and thereby destroyed) the old city's extant remains.

A relatively small part of Berenice was, as we now know, safely concealed under the Sidi Khrebish cemetery, in use from the time of the Turkish administration to the 1930s. In the early 1970s, when the municipality of Benghazi proceeded to urbanize the Sidi Khrebish area, the Department of Antiquities at Tripoli and Professor J. B. Ward-Perkins recognized the imminent threat to the hidden remains of Berenice.

The Society for Libyan Studies in London was invited to join the Department of Antiquities in a rescue campaign, which was to become a full-time excavation in 1972–1973. The operation was a major event at the time. At its zenith, it employed over one hundred persons, investigating an area of over 18 000 square meters. It brought to light long-span sequences and an immense wealth of artifactual and immobile find data. [18].

The site excavated by the Department of Antiquities and the Society for Libyan Studies lies within a nineteenth-century Turkish cemetery close to the seafront near the center of Benghazi. It was the clearance of this cemetery by the municipality and the ancient structures thereby revealed which gave rise to the present series of excavations. The site was found to lie on the periphery of the Hellenistic and Roman city of Berenice, and the excavations revealed parts of two different defensive circuits built initially in the Hellenistic period and the mid third century A.D.

Respectively, a grid-plan including courtyard houses and small industrial establishments of various periods, a late Hellenistic shrine (Building X), a large peristyle (Building Ll) belonging to a monumental establishment outside the excavated area (baths?), and on the eastern part of the site a Roman complex of apparently public character (Buildings T and W) cut through by the foundations of a large and very plain Byzantine church (Building G) [19].

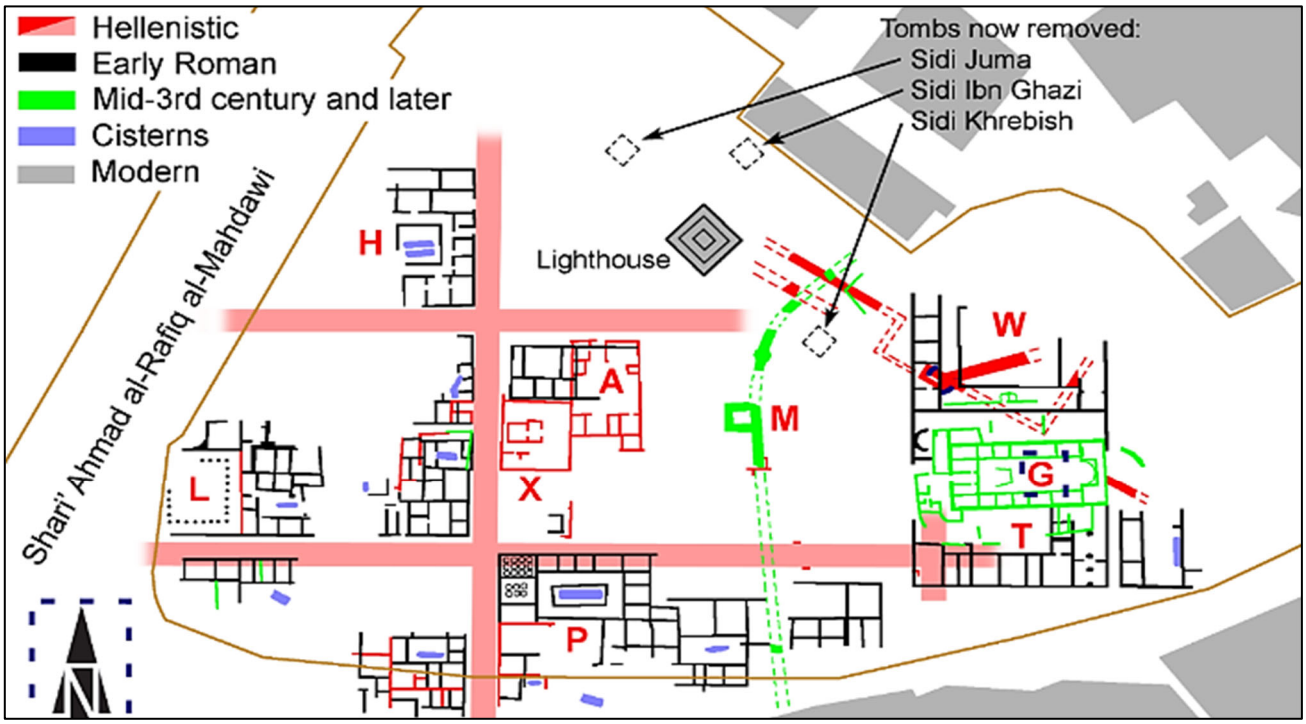


Figure 12: detailed plan of ancient network and buildings.

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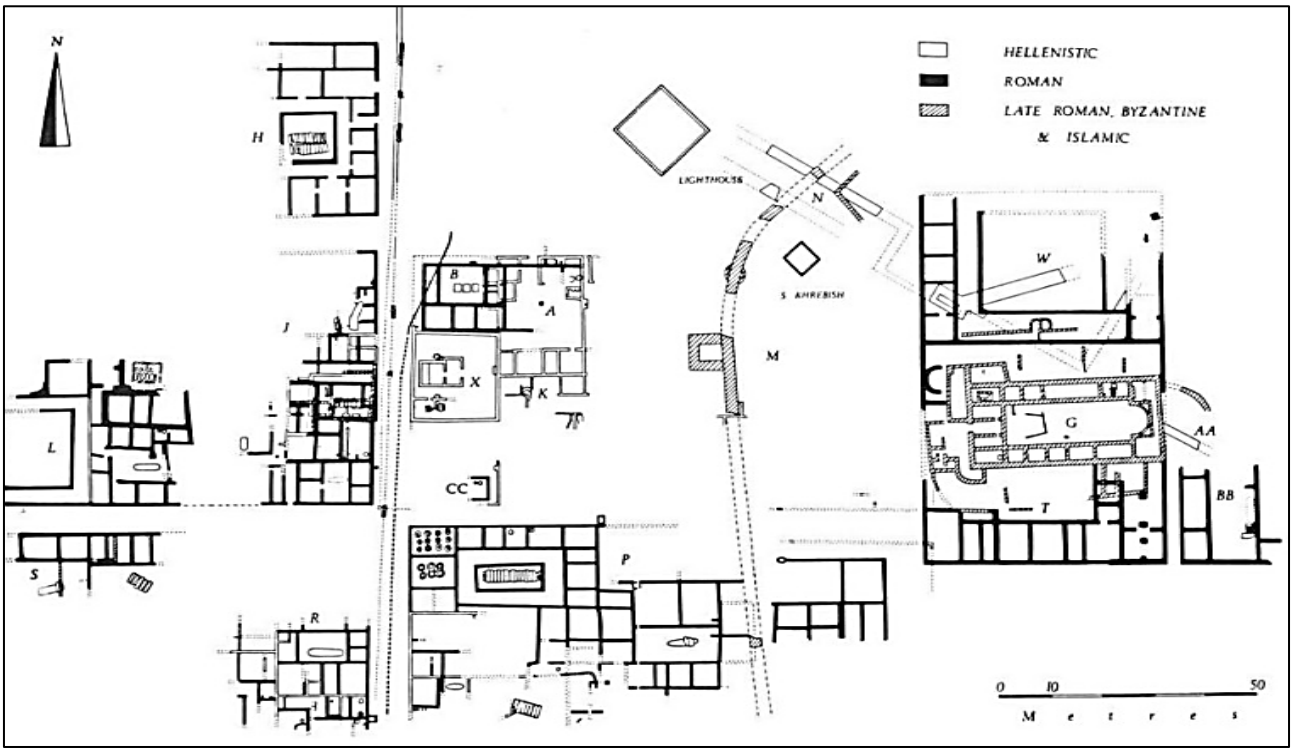


Figure 13: 7 Master Plan of Sidi Khribesh.

3.3 The Importance and Values of Reviving the Ruins of Berenice

- **Historical value:** Heritage is one of the areas of concern for historians. Preserving the architectural heritage of buildings and archaeological sites is promoting the identity of the past, the civilization of the nation, and the continuity of the place. It is said that he who has a past has a present and a future, as some countries promote their future and present with their glorious history.
- The value is social, as it is the basis for preserving the local culture and urban identity, and it enhances the cultural dimension within the community and the sense of belonging and identity.
- A basis for sustainable development: by attracting investment, providing job opportunities, and providing environmental benefits by reducing demolition waste and decreasing the resources required for demolition and reconstruction.
- **The value is aesthetic in its location:** the value includes the characteristics through which the traditional building becomes an important axis in terms of national, cultural or spiritual aspects.
- **Scientific value:** cultural heritage shows the history and life of ancient peoples and shows the diversity and difference between them.
- **Economic value:** The urban heritage and historical areas represent a major source of national income for both internal and external cultural tourism, as a legacy that reflects the history of the region, and cultural tourism is considered one of the fastest growing sectors of international tourism.

4. DISCUSSION AND PROPOSAL STRATEGIES

According to the spatial analysis of the area, a new vision of the place can be created using the hologram technology. That is to create a virtual district where the visitor can have an enjoyable experience walking among the virtual buildings as the most powerful way to revive it.

Using a holographic projection system to reconstruct Sidi Khribish ruins can create immersive experiences for preservation and tourism. Here's a step-by-step approach to how this proposal can be implemented:

4.1 Collect Information:

Gather archives, architectural plans, and archeological discoveries pertaining to the ruins.

Excavation archives as a reference: To start designing a landscape for an archaeological area, it is necessary to search for the original network that existed at that time, where the movement is the same on that network, and for this we searched in excavation research in the area to extract the road network in it and in its light the movement.

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3D scanning: To document the current situation of the ruins, use photogrammetry or 3D laser scanning. This will provide restorers with a detailed model.



Figure 14: Example Of 3D Scanning the Current Satiation of the Ruins.

4.2 Model Creation

3D Modeling: Using the data collected, create a 3D model using tools such as Blender, SketchUp, or Revit. Make sure the model matches the structure's historical development.

Textures and Materials: To increase realism, use textures and materials that correspond with the original construction.

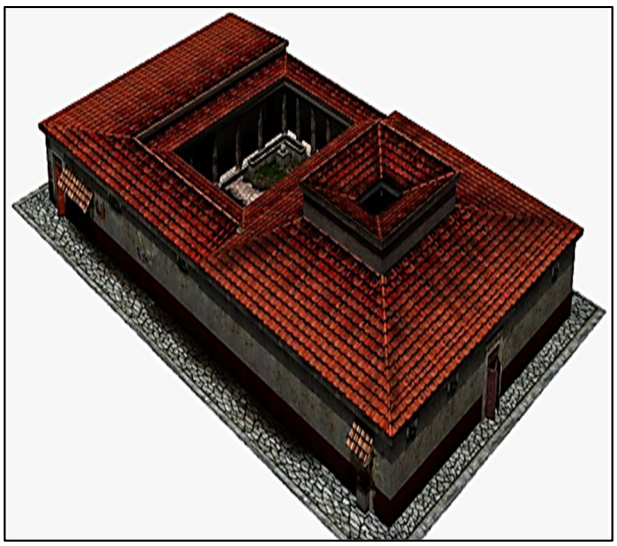


Figure 15: Domus House Roman 3D Model.

4.3 Installing a Holographic Projection System The installation of technology:

Place screens, projectors, or augmented reality devices so that the holograms appear most effectively in the planned settings. In this case, the best view is from the sea (waterfront view) as well as the marine pedestrian paths along the sea.

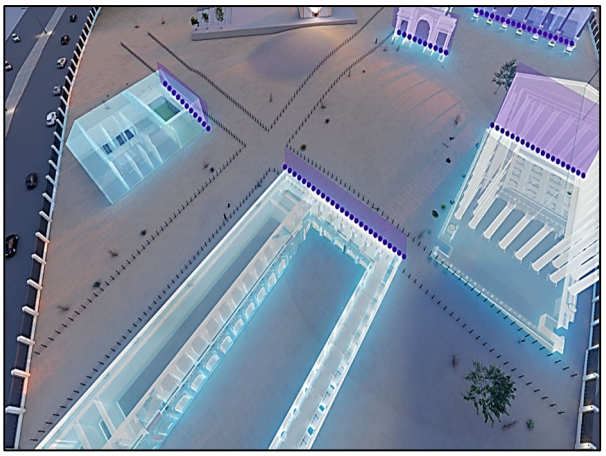


Figure 16: 3 Holographic projection system display placements.

4.4 Combining Interactivity and Integration The interface design:

Provide an intuitive user interface that enables users to engage with the hologram by enabling them to view it from multiple angles, magnify specific details, and access historical information.

Dynamic elements: Take into consideration adding functions such as audio tours, informational touchpoints, or even augmented reality experiences that allow visitors to view the ruins as they were originally intended to be seen.



Figure 17: View from the seaside, prepared by the researchers.

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4.5 Taking advantage and promotion

Viewers launch: To present the holographic reconstruction to the general audience, organize a launch event or exhibit.

Awareness and education: Work with organizations and schools to integrate the projection system into instructional initiatives.

This approach can create a compelling and educational experience that brings the past to life for visitors.

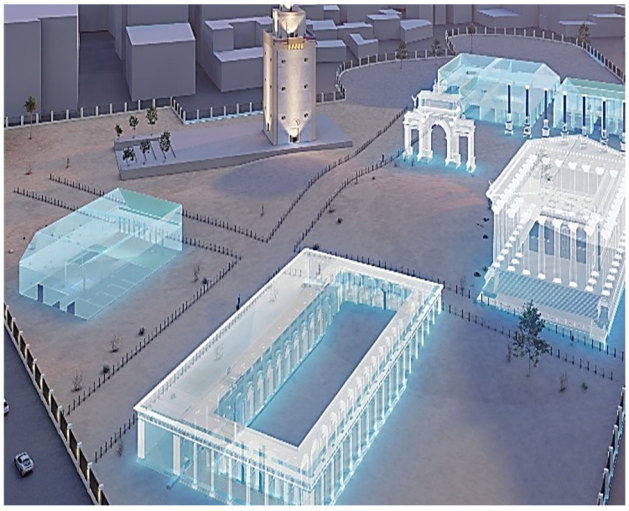


Figure 18: Aerial perspective of holographic projection proposal prepared by the researcher

Limited access: suggesting setting up chains to direct the visitor for movement inside the place where movement is restricted, out of concern for the ruins in the area, to allow wandering inside without disturbing or tampering with it.

5. CONCLUSION

From this study, we conclude that the Sidi Khreibish area in the Old City of Benghazi is a very important archaeological area in terms of its scarcity. However, since its almost complete disappearance, it has lost its importance for the city. Moreover, the Benghazi Lighthouse is an important landmark and a real masterpiece in the architectural heritage. It blends Ottoman and Italian influences to create a unique and iconic structure. Its rich history and cultural significance make it an important landmark for the people of Benghazi, as it stands as a symbol of strength and resilience in the face of adversity. Through extensive architectural conservation and restoration work, the lighthouse will continue to shine brightly for years to come, guiding sailors safely to port and inspiring hope in the hearts of all who see it.

The study attempted to highlight the importance of the archaeological area of Sidi Khreibish once again by using hologram technology to redesign it virtually. Through the submitted proposal, the Greek region and the Roman ruins of the Sidi Khreibish region were highlighted and revived, as well as allowing movement in the region in a limited manner in the original Roman road network as a default reference for the proposal.

It is very important in the field of architectural and urban heritage preservation and revitalization to anticipate a new type of landscape that connects reality and visual imagination and create a new dialogue between the past and the present, where people can move between this specific landscape and cherish the new “free eye” experience.

Also, lighting and lasers can be used on occasions to write and draw on the lighthouse to express the current event in the area. It is also possible to embody a dynamic movement in the area, such as birds, animals, and residents in the area, as if it is a vital area that carries the historical era of the Greek region and Roman ruins, which makes it very interesting.



Figure 19: Proposed waterfront, prepared by researchers.

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