



# **Augmented Reality Utilization in the Documentation of Suez Canal Region Historical Cities Architecture Styles - Case Study: Ismailia City**

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## **ABSTRACT**

Today the world is losing its architectural and archaeological cultural heritage faster than can be documented. Human-caused disasters, such as war and uncontrolled development, are major culprits. Natural disasters, neglect, and inappropriate conservation are also among the reasons that our heritage is vanishing. The need for documented data base for the heritage of historical cities is essential especially in this era where new developments arise every day.

This research addresses the need for historical architectural database as follows, the first part of the research is conducted using theoretical approach where the architecture heritage documentation definitions and need is explained, then the technology of Augmented reality is discussed and its process explained, finally the research takes practical approach where an AR application is programmed by the researcher to document and create database for Mohamed Ali ST. in Ismailia city.

This research proposed the use of Augmented Reality (AR) technology as a new technological method that can be used to document architectural heritage of historical cities and make it accessible for different kinds of users like architects, engineers, students, or tourists.

**Keywords:** Architecture Documentation – Ismailia Heritage – Augmented Reality – Extended Reality – Suez Canal Region Heritage – Architecture Styles

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## **1. Introduction**

Architecture heritage documentation is one of the most important procedures to ensure the preservation and protection of heritage buildings. It is necessary to preserve the building from the knowledge of its data and its history because the documentation is an identification card in its value and condition. The conservation process is based on a comprehensive study and understanding of the building's conditions, resulting in the identification of a plan and the method of dealing with it without compromising its value.

Today the world is losing its architectural and archaeological cultural heritage faster than it can be documented. Human-caused disasters, such as war and uncontrolled development, are major culprits. Natural disasters, neglect, and inappropriate conservation are also among the reasons that our heritage is vanishing.

This study is going to explore the utilization of augmented reality technology in the digital documentation of architecture heritage of lost historical cities, as a simplified more applicable tool for the documentation, decision making and research purpose, necessary before the determined preservation action on the historical site.

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## **2. Literature review**

Previous studies discussed the integration of augmented reality in heritage preservation (Naai-Jung Shih, 2021),(Kolivand et al., 2018) , (Boboc et al., 2022), (Aziz & Siang, 2014), (Yongtian Wang, 2009) and (Digital Workflows for Heritage Conservation, 2017), Nguyen (Nguyen, 2023) argues that In the coming years, augmented reality will be more widely accessible, and more people will be eager to use it. For the purpose of promoting local public awareness of historical sites using the intelligence model obtained to produce virtual tours, organizations and businesses started to use this technology in the field of cultural heritage to provide more realistic experiences for tourists and museum visitors.

Another survey on the applications developed for the utilization of augmented reality in heritage preservation and documentation was conducted, (Younes et al., 2017), (Greci, 2016), (Pierdicca et al., 2016) and (Narciso et al., 2015), in his recent study, Vensada argues that In Augmented Reality applications, the interaction was kept simple, and standard methods for mobile devices were used. The users were excited to navigate through the 360 videos by moving their devices around them.

Through this review a gap was concluded that there is little research on the integration of augmented reality as a documentation and visualization method for the architects, students, local communities, and visitors, in the outdoor historical district exhibition using simplified digital technology.

Here introduces the paper, and put a nomenclature if necessary, in a box with the same font size as the rest of the paper. The paragraphs continue from here and are only separated by headings, subheadings, images and formulae. The section headings are arranged by numbers, bold and 9.5 pt. Here follows further instructions for authors.

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### **3. Research Methods**

The methodology applied through this research consists of three parts, first a theoretical background about heritage preservation processes and importance, then introduction to the digital methods utilized Augmented Reality, second, a literature about the selected case study of Ismailia is discussed, finally, an application is developed for the utilization of augmented reality as a visualization and documentation software that is easily accessible and user friendly.

#### **3.1 Heritage Documentation**

Documenting the architectures is very important for many different reasons. Some of the reasons are, To convey the system architecture to the developers of the system so that they understand the rationale behind some of the decisions taken, To communicate the system evolution information to different stake holders of the system, Documentation of some of the key architectural decision have a far-reaching effect during its enhancement and maintenance phases, Documentation of not just the final architecture but also the alternative architecture gives the rationale behind the selection of current architecture.(Guney et al., 2003)

##### **3.1.1 Organizations that work on documenting the Egyptian heritage**

Documentation is carried out through the various conservation phases, like before, during and after completion of the building so that the amount and type of intervention carried out during conservation and restoration work can be determined. (urbanharmony, 2010)

The following organizations are responsible for the documentation of Egyptian heritage.

1. Committees for inventory and registration of heritage buildings
2. National Register of Heritage Buildings
3. National Organization of Urban Harmony (NOUH)
4. The archaeological map of Egyptian heritage sites
5. Centre for Documentation of Cultural and Natural Heritage (CULTNAT)
6. Project of Documentation of Heritage Buildings in Cairo Governorate
7. Management and conservation of heritage in Egypt and Syria (HERCOMANES)

#### **3.2 AR (Augmented Reality)**

Augmented Reality (AR) is a live, direct or indirect view of a physical, real-world environment whose elements are augmented (or supplemented) by computer-generated sensory input such as sound, video, graphics or GPS data.(Portalés et al., 2010)

##### **3.2.1 Types of AR**

There are two broad types of augmented reality, these being marker-based and marker less:

A.Marker-based AR uses image recognition to identify objects that have been pre-programmed into your AR device or app.

Here's how it works: First, the camera feed is switched to grayscale to speed up processing time. When it detects a marker (often something simple but distinct, like a QR code), the device compares the information from the marker with all the markers in its brain. Once it finds a match, it uses the marker's information to mathematically determine the pose and it then displays the AR image at the exact right place.

B.Marker less AR is a bit trickier. Not having markers means that nothing has been pre-programmed into your device—it must recognize items on the fly. The recognition algorithm in your device looks for patterns, colours, or other features that might tip it off.(Guney et al., 2003)



Fig 1: Augmented Architecture, Source: Williamsburg + Bradbury | NYC + LA | 2012, London, <https://www.heavy.io/momoar>, Accessed: 19\5\2019, 4:51 AM

### 3.2.2 Advantages and disadvantages of augmented reality

According to (Billinghurst & Kato, 2002) augmented reality provides:

- Augmented Reality enhances interaction and provides a better user experience.
- AR blurs the line between what is real and what is digitally generated.
- Reality with more information added to it that is normally not available.
- Step-by-step instructions and guidelines are presented more accurately through an augmented video than the normal videos.
- Seamless interaction between real and virtual environments.
- The ability to enhance reality.
- The presence of spatial cues for face-to-face and remote collaboration.
- Support of a tangible interface metaphor for object manipulation.
- The ability to transition smoothly between realities and virtually.

With so many advantages, augmented reality also have some flaws existing in it. Some of the concerns are:

- Lack of privacy.
- Augmented reality systems are costly and difficult to maintain.
- Spamming
- Physical danger
- Unauthorized augmented advertising

### 3.3 Ismailia City Case study analysis

Ismailia governorate is one of the three cities of Suez Canal, it was selected as a case study due to the gap it suffers between the city heritage and its residents, the architects working within the city make their design decisions based only on the current modern style and the client style, it's identity is under the threat of being demolished and erased.

#### 3.3.1 Suez Canal heritage

The Suez Canal is a 193-kilometer sea-level waterway that connects the Mediterranean and Red seas. Designed by French engineer Ferdinand de Lesseps, the canal was dug in 1859 and took 10 years to complete. Around 6,000 foreign guests attended the opening of the Suez Canal in November 1869. About one million Egyptian workers are believed to have taken part in digging the canal. Around 125,000 of the forced laborers died in the process, according to Egyptian historian George Kirlis.

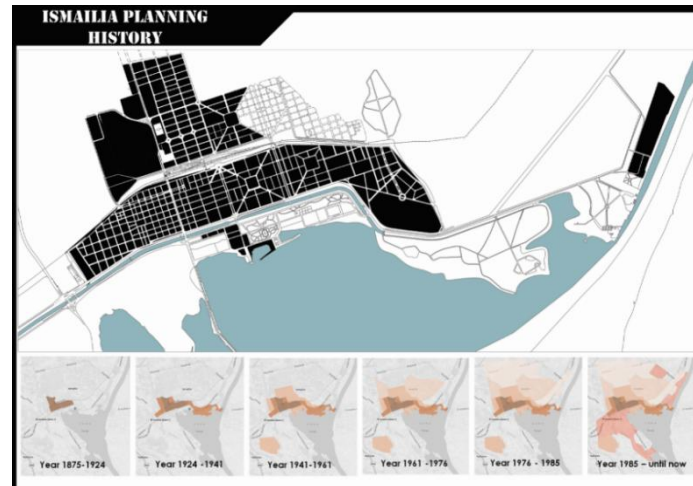


Fig 2: urban development of Ismailia city, source: researcher, 23/02/2021, 01:17AM

### 3.3.2 Suez Canal Cities Existing architectural character.

The architecture styles that were influenced by to build the 3 cities are similar to each other as they can be filtered into two main categories, The European architecture style in which the French, British and Italians engineers that supervised the work on Suez Canal lived, the other Islamic, oriental style in which the Arab workers lived.

#### A. European Architecture Style:

The European style in Suez Canal region consists of various types as the engineers, workers and residence of those cities were scouted from all over the world, the most common style in Suez Canal cities is the Neo-classical Colonial style.

The urban villas that can be classified in that style are free standing large two or three stories colonial style villas. They are made of wood and bricks and have spacious terraces overlooking their private garden. They all have pitched roof which is only common within the French planned part of Ismailia, Port said and Suez.(Megahed, 2014)

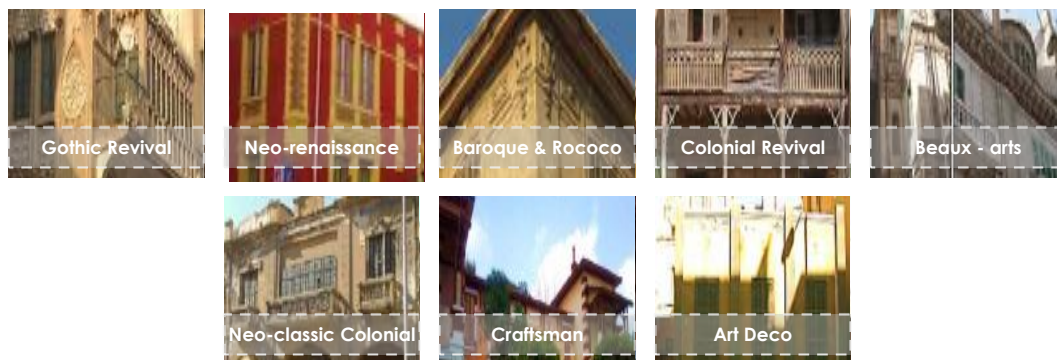


Fig 3: European architectural styles, Suez Canal Cities, Source: Heritage-Based Sustainability in Port Said: Classification of Styles and Future Development, Naglaa Ali Megahed, Port Said University

#### B. Arab and Islamic architectural styles

The Arabian style in Suez Canal Cities can be classified into two main styles which are: Neoclassical style and Moorish Revival style, the Neoclassical style is the most common as it was used in the residential buildings of Arabian workers, the buildings still reserve many of its beautiful wooden buildings with extruded terraces that shade the ground floor sidewalks.

The Moorish revival style was used in the administrative buildings and those buildings were mainly free-standing courtyard large building. Some of the buildings were inspired by the elements of Islamic architecture. (Stefanie Anna Maria Wladika, 2015)

3.3.3 Analysis of Ismailia heritage architecture styles

Ismailia is a city in north-eastern Egypt. Known in Egypt as "The City of Beauty and Enchantment", Ismailia is situated on the west bank of the Suez Canal, it is the capital of the Ismailia Governorate. In the 19th century, the historical base for the city was built right off timsah lake along with a railway connecting what will later be known as Ismailia, the city grew around the timsah lake and out towards the vast surrounding desert.

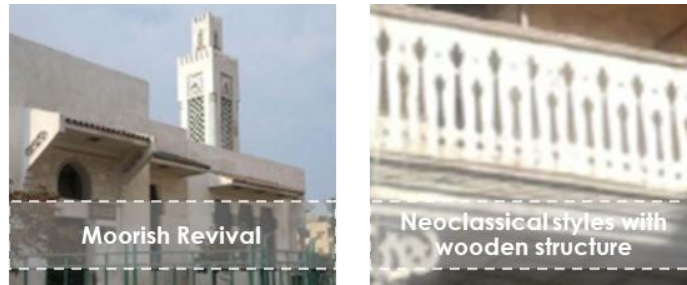








Fig 4: Arab and Islamic Architectural Styles, Source: Heritage-Based Sustainability In Port Said: Classification Of Styles And Future Development, Naglaa Ali Megahed, Port Said University

The architecture of Ismailia is clearly representing the style of European 19th century architecture – mainly the style of the southern European Mediterranean. Wooden galleries, also called verandas. The verandas characterize the ‘tropical’ architecture and were recommended for the well-being and thermal comfort of its inhabitants. The wooden galleries as kind of ‘second skins’ should protect the building’s facades from direct rays of sun. This kind of ‘tropical’ architecture can be found all over the world, in former colonial cities. But the special aspect in Ismailia is on the one hand ‘the height’ of the buildings with its three to four, sometimes five floors and the scale of the constructions. (Megahed, 2014)

Table 1: Architecture Styles in Ismailia City, source: researcher

Architecture Style	Ismailia	Descriptive Image	Architecture Style	Ismailia	Descriptive Image
Neo-renaissance	Greek Workers villa in Al Emam ST.		Neo-classical Colonial	SCA head quarters	
Baroque & Rococo	Greek Workers villa in Adli ST.		Craftsman	Villa Delessps	
Colonial revival	Workers Villa		Art deco	Workers Villa	
Beaux arts	SCA Social Club				

## 4. Results

This research purposes the integration of augmented reality in the documentation and exhibition of historical districts to architects and public, the following application was developed as a proof of concept to the simplicity of the process and the production of a user-friendly digital aid.

### 4.1 Case Study (Chamblyon Square in Mohamed Ali ST.) Background

Mohamed Ali Street contains the office of the Suez Canal Administration, a huge heritage building overlooking the street and its face decorated with buildings bearing French and Ottoman architecture, and was located near the building, the palace of the French engineer Ferdinand de Lesseps, and was the first residential building in Ismailia, on 27 April 1862. At the end of the street was the Khedive Ismail Palace in the same year, and Mohamed Ali Shahid Ali Street, the first tram line in the history of Ismailia, on March 28 1888, which starts from the first Sala Bridge and ends at the palace Khedive Ismail. Champollion Square in the center of the Afranj district is one of the most famous squares in the city of Ismailia. It was named after the French scientist Jean-Francois Champollion, who deciphered the ancient Egyptian language.



Figure 5: Chamblyon Square, Source: [https://elevation.maplogs.com/poi/ismailia\\_ismailia\\_governorate\\_egypt.356730.html](https://elevation.maplogs.com/poi/ismailia_ismailia_governorate_egypt.356730.html)

### 4.2 Working Structure

Application objectives and aims.

- Aiding in design decisions and urban development strategies in historical areas
- Documenting architecture style of forgotten small cities historical core
- Educational purposes for school, college, and higher education
- Branding of the city, for investment, future planning, and urban development
- Tourism guide for tourists and attraction methodology

Following is a diagram in which the process of building application is summarized:

### 4.3. Workers Villa in Chamblyon Square

There is a series of solid buildings, mostly erected in Ismailia from 1863: houses located at the corners of Place Champollion; villas of the chief engineer, chief of transit and governor of the isthmus, offices of the Company and palace of the khedive along the freshwater canal.

These modest buildings, except the palace, represent one of the variants of the "bungalow" that spread from the 19th century in colonial French and British empires.

They are characterized by a central volume on one or two levels, in neoclassical style with a decoration limited to the frames of the bays and to the cornice bands, to which is systematically added a veranda or wooden gallery provided with valances and ornate railings. In the constructions of the end of the 1860s, bricks were also used to make openwork railings like those of the terraces of "houses for Egyptian officials", of the khedive's chalet or even of the first station of Ismailia (1867).



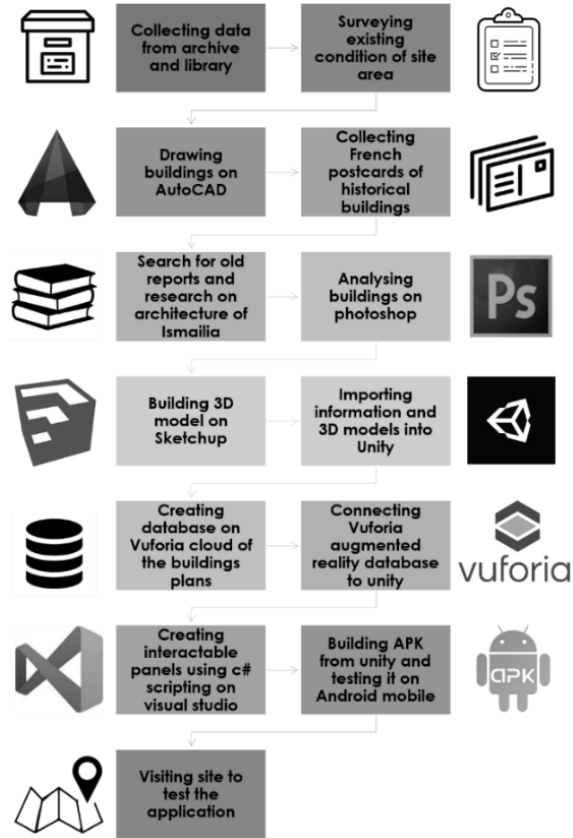


Figure 6: Process of building application, source: researcher

**5. Conclusion**

Ismailia city is one of the small cities in Egypt that has distinguish architecture style that is neglected and built upon by new developments and massive structural buildings, the need of accessible data base of the architecture style and its features is essential for architects, engineers, planners, officials, students, and academics to have a clear and true vision of Ismailia city and its heritage.

The AR application was created using unity game engine, Vuforia data base, Visual studio programming software and was tested on Android operating system on Samsung Note 10 lite mobile.

This research proposes creating portable augmented reality application that can be used on all electronic devices which will document the architecture style of historical buildings in Ismailia city, to ensure that the preservation of historical city core’s style and identity.

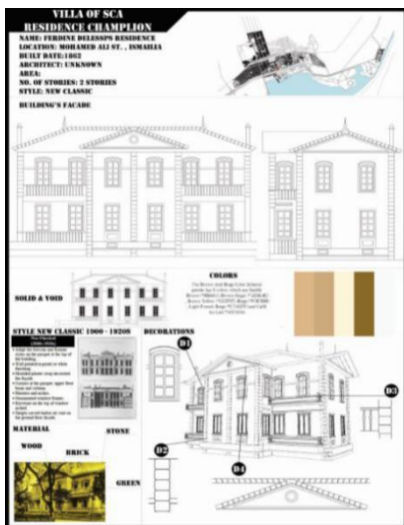


Figure 8: Info in Augmented Reality Application, Source: Researcher Figure 7: Workers Villa in Chamblion Square, source: researcher

## 6. Abbreviations

VR: Virtual Reality

AR: Augmented Reality

ST: Street

NOUH: National Organization of Urban Harmony

CULTNAT: Centre for Documentation of Cultural and Natural Heritage

GPS: Global Positioning System

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