

**Inanimate objects back to life using AR**

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**Abstract**

Because of a lack of awareness about the history and heritage of ancient Egyptian civilization. Tourists sometimes suffer from the lack of knowledge of historical information about statues and hieroglyphic language inside museums. The forgotten Egyptian Museums need some actions and excitement to bring them back to life. Egypt has a treasure of museums that hide the beauty of history and cultural heritage.

Industry 5.0 and the research introduce a new interactive image for those museums to back them to life, not only to re-open them but to enjoy and live in these ages and history to feel the experience. Augmented Reality (AR) will help those museums. It uses technology to superimpose images, text or sounds on top of what a person can already see. It uses a smartphone or tablet to alter the existing picture, via an app. The user stands in front of a scene and holds up their device. It will show them an altered version of reality. Augmented reality has found many unbelievable uses in various industries like the E-Commerce industry, Real Estate Industry, Prototyping Expenses, Education and Tourism. Our case study is using AR technology in tourism. AR is a powerful visualization tool. As it allows bringing an object or concept into a reality that is otherwise imagined, inaccessible or difficult to grasp, and can even help to make the invisible visible. In this way, this research collects abandoned Egyptian museums and explains how AR brings them to life. That will let you live the whole experience and let the community understand the cultural heritage with these examples of attractive case studies.

**Key Words:**

Inanimate objects- AR- Museums in Egypt- Open-air museums

**Introduction:**

**1. Museums in Egypt**

Egypt has a great wealth of historical monuments, whether Pharaonic, Islamic, Roman or other monuments. There are a large number of Pharaonic and art museums that contain rare and priceless collections. The Egyptian museums vary among historical, artistic, heritage and cultural museums and open-air museums. It was not until the early nineteenth century that Egypt have witnessed the birth of the first national museum on its grounds, as for the market for Egyptian antiquities, and the clear vision of Governor Mohamed Ali Pasha. Yusuf Diya Effendi was entrusted to transform this task into a reality under the supervision of Rifa‘a El-Tahtawy. Close to the school of Foreign Languages, Diya housed the discovered antiquities in a building constructed by Engineer Yousef Hekekyan in the Ezbekiyeh gardens of Cairo. This museum was either known as the Museum of Sheikh Rifa‘a or Al-Antiqakhana. After putting the blame on the Europeans for plundering the antiquities, Mohamed Ali demonstrated his shrewd prowess in the mentioned decree by assuming that the proposed scheme would be in the Europeans’ interests and he posited foreigners instead of the locals as the projected visitors of the museum. El-Tahtawy and Diya optimized the museum by enlarging the collection and preserving the artifacts.

They also appointed inspectors all over the country to send any discovered antiquities to the museum. The 1798 French expedition to Egypt brought attention to ancient Egyptian heritage. Quickly, the western markets for Egyptian antiquities became very active supporting digging in Egypt, following the western madness with pharaonic Egypt. [8]

### **1.1 Types of Museums**

A museum defines as an institution housing collection of objects of artistic historical, or scientific interest conserved and displayed for the educational and enjoyment of the public.[5] Museums are places of memory that provides the link of the distant past to the present generation which also help society to know the path their forebears trod Many types of museum include the museum of Antiquities-in which e housed ancient pieces of furniture or objects of art such as sculptures, paintings, ceramics, textiles and other crafts. Science Museum, with objects depicting the history of science and engineering and Natural History Museum. All types of these have their roles of information institutions in national development. The leading functions are identifying, acquiring, preserving, and exhibiting unique, collectable, or representative objects. [10]

### **1.1.1 Open-air museums**

The first open-air museums were established in Scandinavia towards the end of the nineteenth century. The concept soon spread throughout Europe, North America, and all over the world, along with the development of transportation and tourism. Open-air museums are variously known as Skansen, museums of buildings, living farm museums, living history museums, and folk museums.[13]

This type of museum is defined by the International Council of Museums (ICOM) as "a non-profit making, permanent institution in the service of society and of its development, open to the public, which acquires, conserves, researches, communicates and exhibits, for purposes of study, education and enjoyment, the tangible and intangible evidence of people and their environment." [13] Common to all open-air museums, including the earliest ones of the nineteenth century, is the teaching of the history of everyday living by people from all segments of society. Some examples of open-air museums are as follows:

#### **Wadi Al Hitan**

Wadi Al Hitan, Whale Valley, in the Western Desert of Egypt, contains invaluable fossil remains of the earliest, and now extinct, a suborder of whales, Archeocyte.

These fossils represent one of the significant stories of evolution: the emergence of the whale as an ocean-going mammal from a previous life as a land-based animal. It portrays vividly their form and mode of life during their transition from land animals to marine existence. It exceeds the values of other comparable sites in the term of number, concentration and quality of its fossils, and their accessibility and setting in an interactive and protected landscape (World Heritage Committee, 2012).[6]

Over 40 million years ago the so-called Tethys Sea reached far south of the existing Mediterranean. This sea gradually retreated north depositing thick sediments of sandstone, limestone and shale, visible in three named rock formations which are visible in Wadi Al-Hitan. The oldest rocks are the Eocene Gehannam Formation, about 40-41 million years old, consisting of white marly limestone and gypseous clay and yielding many skeletons of whales, sirenians (sea-cows), shark teeth, turtles, and crocodilians. A middle layer, the Birket Qarun formation, of sandstone, clays and hard limestone, also yields whale skeletons. The youngest formation is the Qasr El-Sagha formation of late Eocene age, about 39 million years old.

It is rich in marine invertebrate fauna, indicating a shallow marine environment. These formations were uplifted from the southwest, creating drainage systems, now buried beneath the sand, which emptied into the sea through mangrove-fringed estuaries and coastal lagoons when the coast was near what is now the Faiyum oasis, c. 37 million years ago.

As an open-air museum, it can be prone to many threats. Damage, theft and vandalism by visitors, including damage by off-road vehicles, are the main current threats to the fossils protected by the site. In addition, Climate change is a growing potential threat, which may alter the rate and impact of natural erosion of fossils with Egypt facing dramatic changes in the climate in the temperatures and precipitation level, including more storms and rainfall in winter, spring and autumn. This will require a comprehensive program for fossil maintenance and conservation. Natural wind erosion also affects exposed fossils. Whilst this is a natural process and can be considered part of the dynamics of the site, the fragility of the whale skeletons is such that they require protection in order to conserve their Outstanding Universal Value.

### **I.Wadi El-Natron**

Wadi El-Natron is part of the Western (Libyan) Desert adjacent to the Nile Delta (23 m below sea level), located approximately 90 km southwards of Alexandria and 110 km NW of Cairo. It is oriented in a NW–SE direction, between longitudes 30°05'–30°36'E and latitudes 30°29'–30°17'N (King & al. 2009). It is about 50 km long, narrow at both ends (2.6 km in the north and 1.24 km in the south) and wider in the middle, about 8 km.[11]

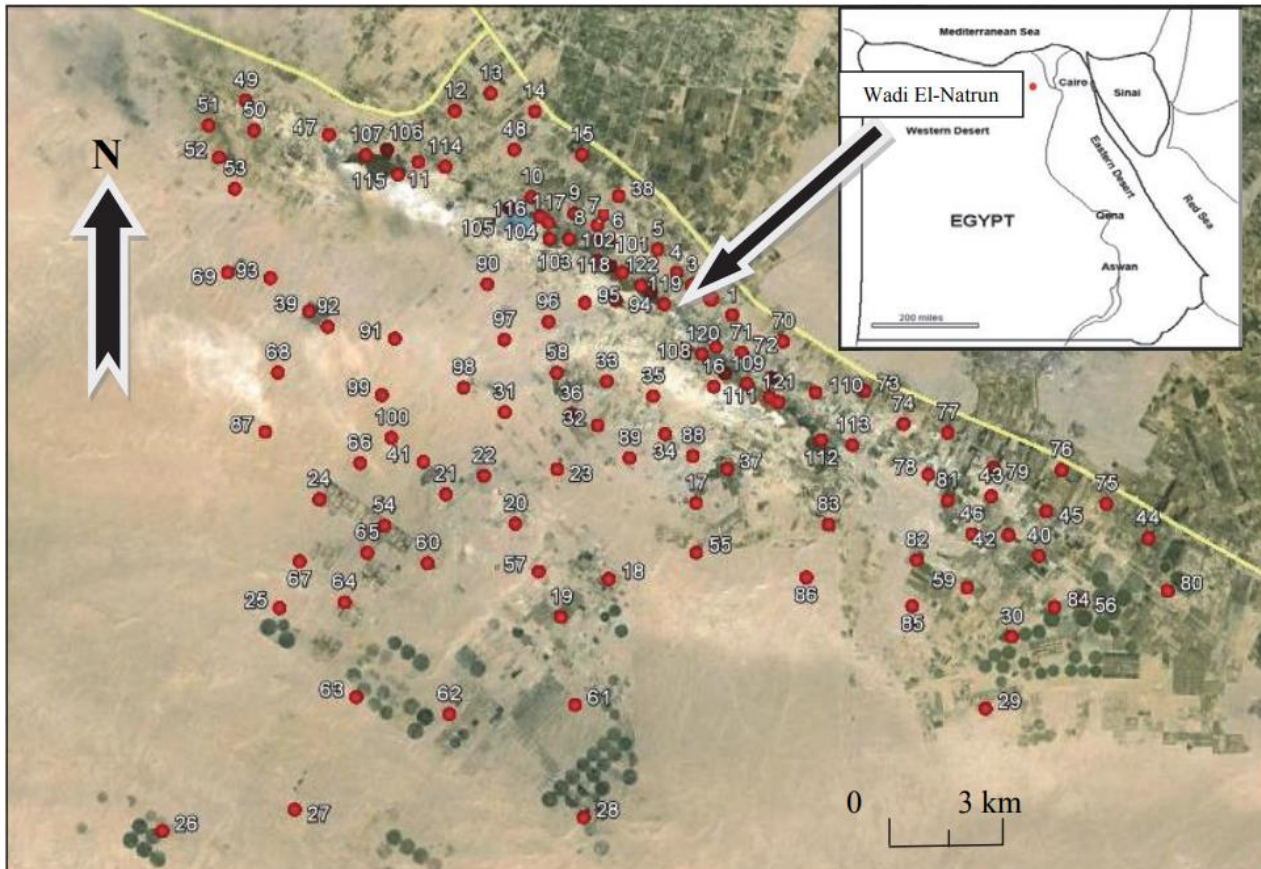
Wadi El Natrun is one of the prime attractions for the Christian religious tourists that come to Egypt, originally, also considered one of the most famous valleys in Egypt. It is considered the home of asceticism and worship, with four monasteries still existing today. The Holy family crossed the Rosetta branch of the Nile to the western delta and headed south into Wadi El-Natroun (Natroun Valley, a.k.a. Scetis) in the Western Desert of Egypt, as shown in figure 1. Before reaching Wadi El-Natroun, the Holy Family passed through the spring of Al-Humra where the Infant Jesus caused a water spring to well up from the ground. The well is called “Beer Mariam” (Mary’s well).[11]

The history of Wadi El Natrun and its importance to the Copts goes back to the 4th century. Anchorites inhabited caves around the valley and built monasteries. After the Arab invasion of Egypt, the Khalifa of Moslems in Arabia gave Christian monks in Egypt the amnesty to practice their religion. For that reason, the area became the official residence of the Coptic patriarch.



Even now the patriarch is elected from Wadi El Natrun monks. Later Christianity reached the area with St. Macarius the Great who retreated there in c.330. Other religious men were drawn to the area, and a sort of loose community was formed. The community grew in number and became more organized, a flourishing monastic system was created.

The visit of the holy family to the land of Egypt is an interesting story which history recorded it for us in all its details Egypt has the right to be proud of all countries of the world because it's specialized for this great honor to be the visit of the holy family in Egypt not to any other country, the holy family remained in Egypt for almost three years, and eleven months, they cut through at least two thousand kilometers was mostly on foot and others inside sailing on the great Nile across its land and people blessed them across Egypt.



**Fig. 1. Wadi El-Natroun**

### **1.1.2 Natural History Museums**

#### **Egyptian Geological Museum**

The Geological Museum was established in the gardens of the Ministry of Public Works in downtown Cairo and inaugurated in 1904. The building consisted of two floors; all of its exhibits had been collected by the teams of the Geological Survey including minerals, rocks, invertebrate and vertebrate fossils.

Worthy of mention is that the first collection to be displayed in the museum was the Fayum Vertebrate Fossils that is the large horned mammal known as *Arsinoitherium Zitteli* unearthed in 1898 and was sent to London for identification before returning back for display. The museum has a library with a large collection exceeding 11.000 books and periodicals including original rare books versions.[8]

Historically, the Egyptian civilization has been tremendously affected by the availability of different natural materials such as metal and copper, the strength of the army and the weapons used by it were highly dependent of the availability of such materials. Also, different stones were used in the making of jewelry and objects of fine art. Fortunately, Egyptians were pioneers in mining, extraction and the utilization of different materials, such as gold, metal and copper.[12] Never the less, different stones were used in the making of jewelry and objects of fine art. Fortunately, Egyptians were pioneers in mining, extraction and the utilization of different materials, such as gold, metal and copper. A huge collection of metals as well as stones are displayed in the museum: a collection that introduces the visitor to its importance and contribution in the history of ancient Egypt.

Also, a large collection of famous minerals, ores and rocks is on display. The exhibit section includes an invaluable collection of meteorites collected from Egypt and from other places in the world. The meteorites collection includes “the famous Egyptian meteorite “Nekhlite” believed to be from Mars”. [12] In addition, the geological history of Egypt as specified by its fauna and flora is displayed in the museum. The unique collection of the Fayoum vertebrate fossils are on display, as well as invertebrate fossil collection extracted from different locations in Egypt and from around the world. [12] The Egyptian geological museum contains three separate galleries. The three galleries are as follows: I- Minerals & Rocks Gallery, the gallery that includes various specimens of minerals, rocks and meteorites; II-Invertebrate Fossil Gallery, the second gallery that is divided into three sections, which is the stratigraphic sequence (Geological column), Egyptian geology as represented by fossils, and systematic palaeontology; and III-Vertebrate Fossil Gallery, that includes the world-famous vertebrate fossil of Fayoum providence and some other Fossils discovered in different places of the world.

The museum is served by a library with reference that goes back to 1778, in addition to up-to-date references and bibliographies. “It hosts more than 10.000 text books, journals, periodicals, annals and maps,”.[12] The library is open to the public during museum’s opening hours and is used by visitors and researchers. It includes a collection of rare books that are approached by researchers from around the world. The museums have lecture rooms with a cinema screen that is used to play films about the history of the collections and also to give lectures to visiting researchers and students. The museum also includes laboratories where samples are prepared to be used by researchers and students for educational uses, and other samples to be taken away as gifts.

### **1.2 Tourist experience**

A museum visitor fundamentally makes a visit decision based on a desire to satisfy an individual’s (group’s) identity-related needs and based on his/her perception of a museum as a destination where such needs could be met (J. H. Falk & Dierking, 2012).[11]

In the recent years, Egypt has proven to the whole world the mesmerizing facts about ancient Egyptians in the National Museum of Egyptian Civilization, and how Egypt is rich with history. Unfortunately, many other breathtaking museums are unknown due to lack of awareness. Under the circumstances, a research was made to determine the attitudes of both tourists and service providers toward tourism experience, and how this could benefit the left out museums.[6] Tourists were asked about the reasons or purposes that may encourage them to get involved in this tourism experience. The findings showed the majority of interviewees (61.6% of tourists and 60% of service providers) reported that the main reason for engaging in this tourism experience is for entertainment and recreation purposes. Other interviewees (19 % of tourists and 26.6 % of service providers) argued that some people may be interested in this tourism experience to learn about the culture of ancient Egyptians.[6] The following table shows the statistics:

<b>Purposes for engaging in the proposed experience</b>	<b>Tourists</b>	<b>Tourism and hospitality enterprises</b>
Entertainment and recreation	45 (61.6%)	27 (60%)
Learning about ancient culture	14 (19%)	12 (26.6%)

One way that can combine both learning and entertaining experiences is using the AR technology. AR, also known as, augmented reality is the process of using technology to simply add images,

text or sounds on top of what a person can already see through a smart phone or tablet. This can be implemented by downloading an application on the device and holding it up to see all the magic. The next chapter, chapter 2, will give a detailed explanation of augmented reality and its uses.

## **2. Using Augmented Reality in Tourism.**

“AR is an attractive medium for use in museums because digital databases challenge existing archives with obsolescence, and the ever-growing tide of digital information can be reconciled with traditional, physical databases through the promise of AR.” - Geoffrey Alan Rhodes, Filmmaker, Assistant Professor at School of the Art Institute of Chicago AR (Augmented Reality), a technology that imposes layers of virtual content on the real environment, enables a smartphone or tablet user to aim the device at a designated point and watch a still scene come into life. The ubiquity of mobile devices use has provided the public great opportunities to get familiar with AR applications in various spheres. For tourism, the appeal of AR is clear – the technology allows rich media content such as graphics, animations, and videos to be layered upon real environments, which provides a way for museums to bring collections to life.

[1]



The augmented reality superimposes the calculated data on an objective view to effectively stimulate the sense of actual surroundings and achieve active interaction between the subscribers and the content. Thus, the significant reason behind augmented reality becoming increasingly popular is that this technology has proven to provide more personalized content and services to new interactive and highly dynamic experiences that satisfy most people's unique needs. Furthermore, the historical and cultural relics can be displayed by augmented reality and virtual compositions compared with viewing pictures from books in the real world. Thus, presenting a richer sense of scale and characteristic of no harm to the tangible cultural relics. This encouraged many cultural tourism organizations to employ augmented reality to enhance their visitors' experience, such as augmented reality in Dublin, Deoksugung Palace in South Korea, and the exhibition center at Manchester Art Gallery. These museums employed innovative tools like augmented reality to help their visitors deeply experienced the displayed content and historical trajectory. As a result, the augmented reality is gradually becoming another mainstream of museum visiting.



Augmented Reality is an elongated technique of virtual reality. It mainly employs image input to capture real-world scenes for locating and overlaying the virtual images or animations on a real-time calculation in the system and then presenting them through an augmented reality indicator. According to Azuma et al. (2001), there are three characteristics of augmented reality:

- (a) integrating real and virtual objects into reality,
- (b) collaboration between real and virtual objects, and
- (c) real-time interaction between real and virtual objects.

Therefore, the images and sounds generated through augmented reality can significantly enhance the visual and auditory experience in real life. Furthermore, the real-time scenes through calculation could improve a more meaningful experience during the transversion that employers experienced. [1]

The following research provides a view into AR technology and opportunities for its use in museums.

### **2.1 What is Augmented Reality?**

Augmented Reality, also known as AR, provides a live view of a real world environment with elements that are augmented by computer-generated images. Generally speaking, AR applications for smartphones usually include GPS (Global Positioning System) to pinpoint the user's location and detect device orientation by using the compass. Unlike Virtual Reality (VR), which provides an entire artificial environment,

AR makes use of the existing environment and overlays new information on top of it. It blurs the line between the reality and the computer-generated information by enhancing what we see, hear, feel and smell. Pokémon GO, the popular game released by Niantic Inc. in the summer of 2016, is a great example of how location-based AR has transformed the gaming experience. Not only AR has found its place in gaming – it also has become a novel medium that offers new layers of interpretation to museum collections. According to the 2012 Mobile in Museums study, 1% museums in the United States have started embarking on AR as a mobile feature. [15]

## **2.2 Required Devices for AR.**

By multi-purpose mobile devices, we mean mobile computers, which are nowadays frequently represented by notebooks/ultrabooks, smartphones or tablets. In education of history and tourism, the use of augmented reality is destined for outdoor use with a high degree of mobility of the user. For this purpose, it is necessary that the application enabling displaying the augmented reality runs on computers with high degree of mobility. This means very low weight, small dimensions and due to the low power consumption and high-capacity batteries also several hours of operation without the need of recharging. Internet data transfer is provided by wireless connection, preferably available everywhere via mobile data networks.

Smartphone and tablet best suit these requirements, for they have very small dimensions and easier handling possibility (compared to notebooks) thanks to extremely low weight (usually no more than 0.5 kg, which is significantly lower than most notebooks and even ultrabooks, where the weight is at least double) and sufficient battery life. The essence of augmented reality is to display digital content in real images. Everything happens within a touch screen of mobile device that captures the true picture by the front webcamera. The location of digital content must match the actual content as closely as possible eg, the original historical entrance must be displayed on the screen exactly on the point where the entry to the current building is. Therefore the ability to accurately display augmented reality requires advanced technologies, which the mobile device must provide. These technologies include:

- Front web camera to capture the actual image in front of the user's eyes.

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- GPS (Global Positioning System) satellites enabling very accurate location (accuracy within 5 to 20 meters) of the device anywhere on the Earth (called geolocation) and technologies such as gyroscope and accelerometer that can additionally determine the directional orientation and speed of movement of the mobile device, respectively the user, to display an adequate augmented reality in his vicinity. In the event that GPS is not available in the device, this technology can be substituted by the geolocation service provided by companies such as Google, Microsoft, Apple or Mozilla, which use WiFi technology, but this is only possible in areas adequately covered by these networks, ie. in urban areas. Geolocation using WiFi GPS provided in urban areas of the Czech Republic has slightly lower accuracy, which reaches the level of 21-25 meters in large cities and accuracy of 27-33 meters in smaller towns. - In the event that the application uses data from the Internet, the availability of mobile data technologies (Generation 2G GPRS / EDGE, 3G UMTS / HSPA / LTE or 4G LTE advanced or 5G) is essential to provide the actual underlying data for augmented reality in the shortest possible time to ensure fast response time (preferable at least 3G technology providing transmissions with the speed of several Mb/s or more and the best connectivity is 5G). [18]

### **2.3 AR and museums.**

According to the 2015 Trendwatch Report, digitally mediated personalization and personalized learning are two global prominent trends in museums in recent years. A majority of museums with over 50,000 on-site visitors are using new mobile-only technology. Through mobile apps, museums can provide supplemental information about an exhibit or the museum itself; or as a personalized mobile guide through the museum collection or gallery spaces. As QR codes, mobile phone guided audio tours, and smartphone apps have become widely used mobile features in museums all over the world, some museums are starting to explore ways to weave in more interactive and customized features that can enhance visitor experience. Already on a path of convergence with mobile technology, AR has become a portable tool for discovery-based learning that can enhance the information available to patrons when visiting gallery spaces, interacting with real-world objects, or even exploring outdoor installations.[15] As an example, over 1% of U.S. museums are embarking on AR as a mobile feature. A recent example of experimenting with location-based AR apps out of the museum space is the Chicago 00 Project, a partnership between the Chicago History Museum and filmmaker Geoffrey Alan Rhodes.

“Chicago 00 The Eastland Disaster” app offers a customized AR May 2017 - 2 tour. When the users walking along the Chicago Riverwalk between Clark and LaSalle Streets, with a VR Gallery of images that can be viewed anywhere, the story of the disaster will be revealed in a visceral way. Other museums are experimenting with AR apps inside the gallery spaces. For museum visitors, AR apps on mobile devices are very easy to use. According to the 2014 Digital Revolution report, 69% of people brought a mobile device with them to their last museum visit. People have already been accustomed to holding up their smartphone and other mobile devices to take pictures. Thus, scanning an AR object with the device can easily fit into the museum experience. AR apps have benefited both the museums and its visitors for the three main reasons:

**1. A Stage for Endless Layers of Information.**

AR tools offer visitors the possibility to deploy their own smartphones as pocket-sized screens through which surrounding spaces become a stage for endless extra layers of information. In addition, comparing with the widely used QR codes scanning mobile feature, which usually is a manual tracking system, the AR feature on museum apps work with automated image recognition to realize the scanning of real-world objects. [15]

**2. A Powerful Tool of Engagement.**

By offering location-based AR apps, museums enable visitors to explore information about the displayed artworks by themselves, and enjoy the live camera view when inspecting the details of a work. Visitors do not only gain some basic knowledge of the displayed artworks or the exhibition itself by checking the labels and texts on the gallery walls, but also absorb layers of information on top of the work. When more information is provided lucidly, conversations among visitors is sparked more easily, and there is a strengthened connection between the museum and its visitors. [15]

**3. Creative Tool of Education.**

In addition, AR apps allow visitors to obtain knowledge of the displayed artworks through an engaging and informative way. It also inspires the visitors to discover the details of the displayed works and think beyond the works themselves. Meanwhile, AR can deliver a surprising outcome of kinesthetic learning. According to the findings by the Samsung Digital Discovery Centre at the British Museum, United Kingdom, young children might have trouble holding the phone or tablet steady with one hand while tapping the screen with the other to scan the displayed work. However, after seeing the interaction modeled by adults, children will also easily master the scanning process.

They will enjoy a sense of accomplishment when they succeed, and their imaginations and curiosities may expand when using the live camera view. [15]

#### **2.4 Digital Storytelling using Augmented Reality.**

Stories are central elements in human thinking and communication as it is also a natural way for students to build literacy skills. Digital Storytelling enhances the interaction between users and designers, users, and technology tools and also, gives more power in terms of audio and visual impact. Thus, it diversifies the imagination of people as well as provides a fun and engaging experience. The tools of storytelling have also evolved over time. It went from the spoken word to books to movies to enhancing our reality with AR (Augmented Reality). The immersive character of Augmented Reality makes it the perfect vehicle to tell a story in 3D and have an audience dive into it. This is a quick look at the technical side of AR storytelling; there are three components of an AR story: Assets, User Interactions, and the User Environment.



**Assets:**

All visible and invisible components create the story. It is all the elements of an AR scene that help you tell your story. Those can be 2D and 3D models, audio files or even videos. It finds that 3D models have the biggest effect on the experience when being used in combination with audio. In the assets, when designing AR scenes consider that not every user is going to use the latest device and the fastest internet connection available. Be mindful about the size of the scenes and rather work with low poly models and focus on great user experience than on highly realistic elements in your scenes.[2]

**User Interaction:**

When designing anything that is virtual, user interactions are always key to the experience. AR stories are no exception. The beauty of AR is that we are inviting the user into a 3-dimensional world, which opens the door to a whole lot of different interactions than we are used to in our usual 2-dimensional virtual presence. Interactions can be roughly subdivided into active and passive. Somewhere in between interactions, also there's animations. Active interactions are for example a tap on an object that triggers an action. This type of interaction gives the user a choice and encourage them to engage with the scene. Passive interactions are actions that are triggered through the proximity to an object or simply through the passage of time.

To the user, those are experienced as an element of surprise, as those are usually triggered unconsciously. Animations are usually triggered by interactions, are a great tool to keep the attention of the user high.[2]

**Environment:**

AR stories take place in the real world of the user. Therefore, considering the so-called world layer is so important. Is your scene taking place on a simple surface like a table or does it require a certain amount of space? Working with room-scaled objects allow the user to get drawn right into the scene, while smaller objects let the user take the role of an observer. [2]

**2.5 Augmented Reality Development Tools.**

1. Foreign AR SDK ARKit is the AR development platform launched by Apple in 2017. Developers can use this suite of tools to create augmented reality applications for iPhones and iPads. ARKit helps developers develop AR applications that can support two devices to share the same virtual items, making the AR experience more interesting. [3]

2. ARCore is Google's software platform for building AR applications, which is similar to Apple's ARKit. It can take advantage of advances in cloud software and device hardware to bring digital objects to the real world. The main functions are motion capture, environment perception and light source perception.[3]

3. Vuforia is currently the most popular SDK. The main recognition function supports iOS, Android and UWP, and different SDKS are available according to different platforms. You can choose any one of Android Studio, Xcode, Visual Studio and Unity as a development tool according to the needs. The Wikitude SDK reconstructs its propositions using the development framework of image recognition and tracking and geolocation technologies, including image recognition and tracking, 3D model rendering, video overlay, and location-based AR. In 2017, Wikitude rolled out SLAM technology (simultaneous localization and mapping) that enables object recognition and tracking, as well as unmarked real-time tracking. [3]

### **2.6 Requirements of AR Experience**

For all types of museums that are thinking about using AR apps in their gallery spaces, the following should be taken into consideration:

- Museum's ability: A museum should first consider their financial situation when deciding whether to develop their own AR app or use an existing one. A museum should also consider if the app requires free WiFi access throughout the exhibition space. [15]

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- Museum visitors' needs: The museum should collect information of visitor behaviors and visitor preferences to pre-examine the most effective way to implement AR technology. [15]
- Special requirements for the exhibition: A museum should consider the necessity of using an AR app for its permanent collections or a temporary exhibition. Artwork that requires curatorial and interpretive information, other than the text panels and labels, might be best to feature in an AR app. Museums that have already embarked on using AR apps in gallery spaces should consider the following:
  - An effective evaluation process: A museum should collect data and feedback for their AR app use, and adjust or update various components accordingly. The feedback from visitors can also indicate areas for improvement.
  - Create awareness among patrons: A museum should establish and maintain an effective operation and communication system that supports AR app use. In addition, promotion of the AR app both inside and outside the museum is important to attract new app users. [15]

Effective use of AR apps in gallery spaces can help museums achieve various goals and drive institutional changes. AR apps are not just tools for informational and engagement – they are also educational platforms that encourage observations, spark conversation and ignite imaginations. Besides adding additional interpretation for museum collections, AR apps may also bring surprising value to museums’ educational programming. Finally, they may even add value to children’s museums and encourage kinesthetic learning.[15]

### **3. Case study Implementation plan**

This research is based on “interconnected virtual spaces that let users do things they would not be able to accomplish in the physical world” to provide new experiences by designing novel and enjoyable interactions in intelligent environments that enable us to interact with our surroundings.

This project will take Wadi El-Natrun in the Western Desert as a case study. As mentioned early in this research and According to the Ministry of Tourism and Antiquities, the holy family moved to Wadi al-Natrun in the Western Desert, where the Monasteries of Anba Bishoy, Virgin Mary, al-Surian (the Monastery of the Syrians), Paramus, and St. Abu Maqqar would eventually be founded. We will apply AR technology in different positions and arrangements of displays and tracking objects, depending on the user’s purposes.

This research will be implemented through three main stages: the main stage is studying the path of the holy family journey in Egypt. This stage requires collecting information from the Ministry of Tourism and Antiquities. They can provide us with the required dataset of images to establish the AR concept and OCR (Optical Character Recognition) technology. That is the most important stage to building the required platforms for Wadi El-Natrun. The 2<sup>nd</sup> stage is implementing the required software that will exploit Wadi-El-Natrun which is considered the most attractive stop of the holy family journey due to its ancient, economic, and monastic history. Finally, the AR technology enhanced by deep learning will bring the empty spaces in this region to life.

#### **4. Conclusions**

This research presented survey on Egyptian museums. AR definition and development tool kit used to implement the mobile application enhanced by Artificial Intelligence. The project is not limited to building different platforms for museums only, but it will contribute to the real estate world. It will enable the customers to design their houses under the constraints and conditions of structural design. The project reliability requires very low latency and very high information rates.

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