HBIM as a Tool for Branding Historical Egyptian Sites by Utilizing Augmented Reality

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Abstract. Over the ages, Egypt has been known for its flourished history with the ability and the power to fascinate mankind. Its great heritage appears in several forms that include monuments, tombs, temples, and documents revealing past events, but until the beginning of the 21st century only a minimum share of the secrets and the mysteries were exposed. Egypt’s monuments are deteriorated and out of the spot and has been left without maintenance and development. Numerous monuments and historical sites are ignored and not even considered as a destination for tourists because of the absence of virtuous marketing and propaganda. The planning and management of cultural heritage buildings through digital 3D models has become a necessity to protect and conserve the existing history. Building Information Modelling BIM is considered a main tool adopted by the Architecture, Engineering and Construction AEC sector for its qualities and capabilities. Due to the complexity of cultural heritage buildings the concept of Heritage Building Information Modelling (HBIM) which concerns the modelling, documentation, and virtualizing the heritage. This research will focus on the use of HBIM technology by implementing augmented reality mobile application to upgrade the quality of branding of historical sites in Egypt. The AR will augment Al-Baron Palace, which is the chosen case study. The methodology adopted is literature review, comparative analysis on international case studies of sites that applied augmented reality, and an experiment followed by a questionnaire answered by users to evaluate the usage of such mobile application. The research will conclude with a framework that will provide guidelines for applying augmented reality technology system in order to enhance and promote Egypt’s heritage.

Keywords. Egyptian heritage, Branding and marketing, Heritage building information modelling HBIM, Augmented reality, User Experience.

1. Introduction

The identity of a country is recognized by its history and how that history lasts for centuries. Egypt holds one of the oldest and richest civilizations since the dawn of history [1]. Although Egypt has about two-thirds of the world's heritage history, there is a whole heap of neglecting and lack of maintenance to the structures which affected the country’s touristic sector severely. The problem arouses in the lack of marketing of historical structures which is considered one of the most powerful agents to strengthen the country’s economy, especially in the case of Egypt. The research will conduct a studied framework for utilizing a necessary tool as augmented reality by applying it through heritage building information modelling for the sack of improving the quality of branding of historical sites.

Augmented reality is a type of visual technology that merges virtual information to the real environment. It has been used in various fields such as entertainment, medicine, education, marketing,
etc... Recently, its uses increased and became a demand in most fields for how it is a type of technology that interacts with users and deliver a different experience for them [2]. Augmented reality has been applied in HBIM as a visualization tool for visitors of historical places to have an interesting tour whether on-site or on-distance. Utilizing it in marketing of heritage sites will act as a major attraction for tourists and a rich source of tourism.

2. Methodology
The methodology is conducted in three phases. The first phase starts with data collection through a literature review on understanding the relation between heritage building information modelling and augmented reality by the processes and application of both. Along with a brief introduction to branding through studying its background, types, strategies and how a brand’s level of success could be measured. And lastly an overview on augmented reality to how it could be used in marketing field and its impact on users. Secondly, performing comparative analysis between international case studies of historical sites that applies augmented reality linking it to the condition of an Egyptian historical site and how will the virtual technology be applied on it. Last of all, empirical studies will be applied in the form of an experiment followed by a questionnaire to measure user experience after their contact with augmented technology system.

3. Heritage Building Information Modelling and Augmented Reality
Many research studies were conducted on Building Information Modelling (BIM) and Augmented Reality (AR) to be utilized in the Architecture Engineering Construction (AEC) industry. Researchers proposed different ways to use BIM and AR in the industry such as obtaining frameworks combining these two to be used on construction sites to facilitate the tasks assigned to workers, software systems proposed as mobile applications to access direct information and for dealing with complex BIM models, conducting surveys among workers and managers, and AR mobile applications that have access to BIM and CAD data [3]. The idea of combining both BIM and AR, which is to display digital data on the real environment, has a very positive impact on the construction industry. The most main concern of this combination is to transfer the work from office to construction site. This technology still needs improvements to offer the best service that it can provide as the construction industry is a delicate field that needs precision with no errors.

3.1. Heritage Building Information Modelling HBIM
Heritage Building Information Modelling (HBIM) is a tool derived from BIM that concerns with heritage buildings. It was created to collect and protect the remaining physical and digital data. Therefore, AR became a very useful tool to be used in HBIM that facilitate the collection and the demonstration processes [4].

HBIM is considered as a plug-in to the BIM system that is involved in documentation of the historic data and recording parametric information. The process starts by collecting survey data using traditional methods such as measuring tape, calliper, compass and altimeter and high-tech surveying
techniques such as photogrammetry and laser scanning. The second step is to process the data collected to build parametric objects. The final step is to create the HBIM model with 3D documentation [5].

Generating a 3d model of a heritage building has got a lot of benefits:

- Understanding a 3D model is a lot easier than a 2D drawing or image.
- Studying the exterior and interior of a building.
- Reviewing the structure of the building.
- Go through the different historical periods of the building.
- Ability to consider renovations with studied documents taking into consideration every aspect.

3.2. Augmented Reality AR technology

The arrival of new technologies has dominated the world. It is all based on the element of interaction and connectivity between people. The reality, virtuality and the mixed technologies is forming the surrounding environment by adding objects whether tangible or intangible integrated together [6]. Technologies such as virtual reality VR systems have become very popular, especially among the younger generations as it is a form of pure technology that a person can immerse himself in a world to live, feel and act virtually through graphics and sound effects. It is involved now in different industries such as retail, education, health, commercial, sports, and nearly everything. This created a gap between the real world and the virtual one, which led in creating a technology called augmented reality [6].

4. Introduction to branding

Branding is a process to promote a product whether physical or digital methods [7]. “A brand is a name, term, design, symbol, or any other feature that identifies one seller’s good or service as distinct from those of other sellers” [8]. Branding creates a sense of awareness and identity to a certain selected item that shall be called a ‘brand’, which is defined as a set of physical or immaterial characteristics designed to deliver an image and create a reputation for it [9]. It is a strategy that became one of the most important aspect in business used in promoting a service, product, person or a location. The main objective of branding is to attract different types of consumers to interest them in buying or using a brand, therefore limiting their options to choose the desired item. It includes various of activities that ranges from the innovation of a product and how to brand it using marketing communication skills [9] that could be verbal, visual or interactive.

4.1. Traditional branding vs. E-branding

The image and the value of a brand is controlled by different tools that existed over the past decades. The tools used for branding and marketing is classified into indoor actions such as televisions, radios, or press and outdoor actions such as billboards, posters, brochures or flyers. These means of delivering a brand to consumers is considered a one-way communication technique and has been existing still into the 1990s. However, its effectiveness is decreasing due to the technological rise that conquered the world. E-branding is defined as any means of branding associated by any electronic method such as the internet, social media or websites [10]. Researches showed that companies using e-branding is higher by a quarter than other who do not [11]. This occurred because any online source means of branding allows immediate interaction to the product by receiving any feedbacks and gathering opinions whether positive or negative as the brand is spread on a large scale of individuals in no time and no waste with a lower budget compared to the traditional methods.

Both the traditional and modern techniques of branding serve the same objectives by utilizing several tools and methods to build a brand’s image and value [11]. They can be compared through different aspects:

- Presence/availability: Traditional branding such as advertisements on televisions, radios, or press is considered a temporary message or information to the users, but branding od internet or websites is available and even developed to be up-to-date.
Interaction: This aspect is lacking in the traditional technique; it is considered a one-way communication technique as the users only receive information without reacting back. However, e-branding allows consumers to provide feedback, give opinions, ask questions immediately and companies can take them into consideration for immediate action.

Speediness: The time taken to plan a campaign or advertisement on any means such as televisions require organizing in advance and may take months of preparation. On the other hand, the internet spreads the information way faster than any traditional method due to the wide range of the internet network.

Audience: The users of the traditional tools of branding is decreasing gradually, unlike the number of users of internet and websites that is increasing constantly.

Built trust: This aspect is approximately in equal ratios between traditional branding and e-branding. Its main dominant is customer satisfaction where any opinion can affect the credibility of a brand. Therefore, it is important to always create a supporting community and preserve loyal customers.

4.2. Brand metrics
To measure how a brand awareness, engagement and equity increases or decreases, the brand metrics are used. These metrics depend on measuring the engagement between the user or employee or management or organization and the brand [12]. These metrics are divided into four types. The first type is associated with the relation of a brand to the employees and market. The second and third type is associated with the relation of a brand interaction to the users. The fourth type is associated with the performance of a brand and the users.

4.2.1. Behavioural metric. The behavioural metrics focus on the engagement of the brand with internal factors such as employees and external factors such as the market. Internal branding emphasizes the engagement with the brand to lead to culture corporation, aligning it with leadership and business strategy. The higher management role is to focus on energizing employees to participate in improving the brand and adding value to its quality [13].

4.2.2. Interaction metric. The interaction metrics are considered the main measurements that have a direct relation between the brand and the user. It involves channels with interactive channels such as websites, demo trials, social media, etc.… This type of measurement is done by blogs, websites, and any other interactive channel that users can engage with it to develop their opinion on the brand’s awareness, identity and equity [12].

4.2.3. Perception metric. The perception metrics consider a set of ranges to form users’ opinions of a specific product or service through emotional and latent connections including “awareness, familiarity, relevance, consideration and preference” [13]. These type of metrics aims to determine how a brand could be effective through the previous points of interaction. It focuses on the feeling of a brand to a customer.

4.2.4. Performance metric. Brand effectiveness is a huge measurement for associations to screen how the brand performs in connection to general organization goals and is estimated from both a financial and customer see. Execution measurements assess how customers accept and feel about the brand. An organization's prosperity depends predominantly on its capacity to draw in clients to its items. It is basic for an organization's survival to keep up its present customers and make them faithful to the brand. Client securing, maintenance and fulfillment estimates all contribute [12]. Performance measurements empowers to assess how the various brand-building activities have joined to drive general organization results and range from value premium to steadfastness to a client's lifetime esteem. It assesses how customers "carry on" on their discernments and assesses how brand-building activities legitimately drive general organization results, extending from value premium to
unwaveringness to lifetime esteem of a customer. These measures facilitate a company’s ability to estimate an accurate financial value of brand equity [13].

4.3. Branding using augmented reality.
Recently, augmented reality has been utilized in almost every sector of our daily lives such as education, health, entertainment, etc. Nevertheless, branding and marketing sectors started using augmented reality as a tool in their business [14]. After all, this tool became a ground-breaking way for creating an image for a brand for consumers to be eager to experience products. As mentioned previously that interaction between the user and the product is a demand these days, augmented reality offers the suitable environment that interests the consumer in the branded product [15]. O’Mahony mentioned that a raising technology as the augmented reality adds some exceptional features to the marketing field. He called it “new quality of information” as augmented reality is very simple to handle and use and provides an easy way of communication as it is understandable by users [16]. With this high level of interaction, augmented reality serves as an excellent tool to use in branding and marketing which allows users to engage with the product that will furthermore let them be interesting to buy.

5. Data analysis and findings
Through the research the findings resulted from three methods that are discussed as follows:

5.1. Data gathering findings
- HBIM has a strong relation with AR. The two are correlated with each other in producing 3D visualization of the historical site. HBIMs act as a data collector and storing system while AR acts as a tool of visualizing these data.
- The concept of branding is explained and discussed briefly to help understand how to apply branding on a historical site which is the main objective of the research. It is deduced that using traditional branding techniques is not as effective as using advanced branding techniques associated with technology. With this came the usage of AR technology as a tool of branding.
- AR is now becoming dominant as a tool of branding through various fields and is updating every day. Many studies were conducted on using AR in the branding of historical sites.

5.2. Case studies findings
The comparative analysis of three international case studies that have implemented the AR technology, whether on-site or on-distance or both. The three are analysed according to the type of AR that are used and how this type affected the brand metrics of user experience. The following presents the analysis between the three cases:
- Applying AR as a tool of branding of historical sites increasing the identity of a site.
- According to users’ satisfaction, the use of hand-held device such as mobiles and tablets are better than head mounted.
- Data must be collected correctly for proper visualization of the site.
- Awareness of the historical value of the site increased rapidly because of merging an old and ancient surrounding to a new technology as the AR.
- The interaction between the user and the surrounding environment led to increasing in the rate of visiting the sites.
- The usage of innovative ideas for applying AR through applications that was easy and interesting for a wide range of users.
Table 1: case studies findings

| Points of comparison | Case study 1 | Case study 2 | Case study 3 |
|----------------------|--------------|--------------|--------------|
| Type of AR device used | Head mounted, Hand held | Hand held | Hand held |
| Application of AR technology | *Simulating remaining parts of deteriorated monuments. *Preserve data of the site through the use of HBM. | *Creating an interactive journey through an application. *Raising tourism of sites through the use of technology |

| Interaction metrics | Awareness | Consideration | Reach | Frequency | Web traffic | Social index | Demo trials | Product review | Customer satisfaction | Positive associations | Frame of reference | Purchase intent | Advocacy intent |
|---------------------|-----------|---------------|-------|-----------|-------------|--------------|--------------|----------------|----------------------|---------------------|------------------|----------------|-----------------|

| Improved brand metrics after the use of AR technology | Awareness of the historical value of the site increased rapidly because of merging an old and ancient surrounding to a new technology as the AR. *According to users' satisfaction, the use of hand held device is better than head mounted. The interaction between the user and the surrounding environment led to increasing in the rate of visiting the sites. The second and third case study used innovative ideas for applying AR through applications that was easy and interesting for a wide range of users. |

5.3. Experiment and questionnaire findings
The experiment consisted of a mobile application called “Aurasma”, that is available to be downloaded on android or IOS mobile operating systems. It is an augmented reality interface that photos or videos could be added then augmented on a specific object as for example; an old wall painting as the object with certain information such as (painter name, date of origin, etc…). The experiment was applied on a national case study chosen; Al-Baron Palace. The questionnaire is followed by the experiment to determine the user experience by how the level of knowledge of the participants changed after using the AR mobile application. This all is for the sake of measuring the branding of Al-Baron Palace. The following table is a sample of the photos handled to users to place their mobile phones for information to be demonstrated digitally on the screens.
Table 2: Sample of the experiment

| Physical photo handed to participant | Virtual data displayed on mobile screen |
|-------------------------------------|------------------------------------------|
| ![Image](image1.jpg)               | ![Image](image2.jpg)                      |
| “Voices in the dead of night, furniture moving from room to room, and mirrors stained with blood.” Statue were narrated by locals and residents accompanied the history of Al-Baron Palace. |
| The architecture masterpieces live in the heart of Helicopter. Cairo was built between 1907 and 1911. The mansion is covered with detailed animals and figures inspired by countries like India and Cambodia. |
| In its prime, the palace had luxurious gardens, gold-plated doors, and Belgian mirrors designed. |  

The following table presents the output of the results of the experiment and questionnaire on the case study chosen. It is a comparison between the usage of traditional branding and branding using AR technology on Al-Baron Palace and their relation to the brand metrics criteria.

Table 3: Analysis of national case study

| Brand metrics | Types of branding used | Traditional branding | AR branding |
|---------------|-----------------------|----------------------|-------------|
| Interaction metrics | Awareness            | | | |
|                  | Consideration         | | | |
|                  | Reach/ Frequency      | | | |
|                  | Web traffic           | | | |
|                  | Social index          | | | |
|                  | Demo trials           | | | |
|                  | Product review        | | | |
| Perceptual metrics | Customer satisfaction | | | |
|                  | Positive associations  | | | |
|                  | Frame-of-reference    | | | |
|                  | Purchase intent       | | | |
|                  | Advocacy intent       | | | |

The table indicates the following:

- Increased
- As it is
- Decreased
6. Recommendations
The use of new technologies has its own concerns and users do not adopt easily to them. AR technology systems, comparing it with VR technology systems and similar older technological systems, are considered relatively recent. The application of such a system in historical sites for the sake of its branding has its own limitations. The following recommendations were derived from the findings discussed above. Future research could be continued through taking into consideration these points below:

- Technical problems may encounter while using AR applications since the technology is considered new.
- More studies are needed to understand the usability and maintenance of AR applications taking into consideration users’ opinions.
- The experiment done only included delivering information through pictures. Further research must involve the improvement of the application on a wider site scale and with more complexity of the information and the way it is delivered.
- Further research could be done on the AR technology itself to determine its potential advantages such as audio presentation for users with special needs.

7. Conclusion
The main objective of this research was to emphasize the use of visual technology as a type of marketing of heritage sites by providing a deliberate framework on carrying out mobile augmented reality. This will act as an approach to grab attention to historical buildings that has been neglected to deterioration. The aim of the paper was to enhance the branding of historical buildings in Egypt by the use of augmented reality technology through a conceptual framework.
8. Developed framework

**Figure 2: Research's developed framework**

- **Documentation**
  - Site surveying
    - With the use of traditional methods such as (measuring tape, caliper, compass, and altimeter) or high-tech surveying techniques such as (photogrammetry and laser scanning).
  - Collecting photographs and surveyed data
    - The collected data is transferred to geographical information system (GIS) for exporting site maps.
  - Storing data
    - The collected data is stored in servers database of Heritage Building Information Modeling (HBIM).

- **Augmented Reality AR**
  - Visualization of AR model via mobile application.

- **Data Processing and Modeling**
  - Generating 3D model
    - Through the use of Heritage Building Information Modeling (HBIM) from the collected data.
  - Exporting layers of data to AR application
    - Organizing layers of information from HBIM to AR application.
  - Exporting 3D model to AR application
    - Organizing model from HBIM to AR application.

- **Branding**
  - Measure user experience by brand metrics.
  - Apply augmented reality technology on historical sites in Egypt.
  - Enhanced branding of Egyptian historical sites through the use of augmented reality mobile application technology.

- **User Experience**
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