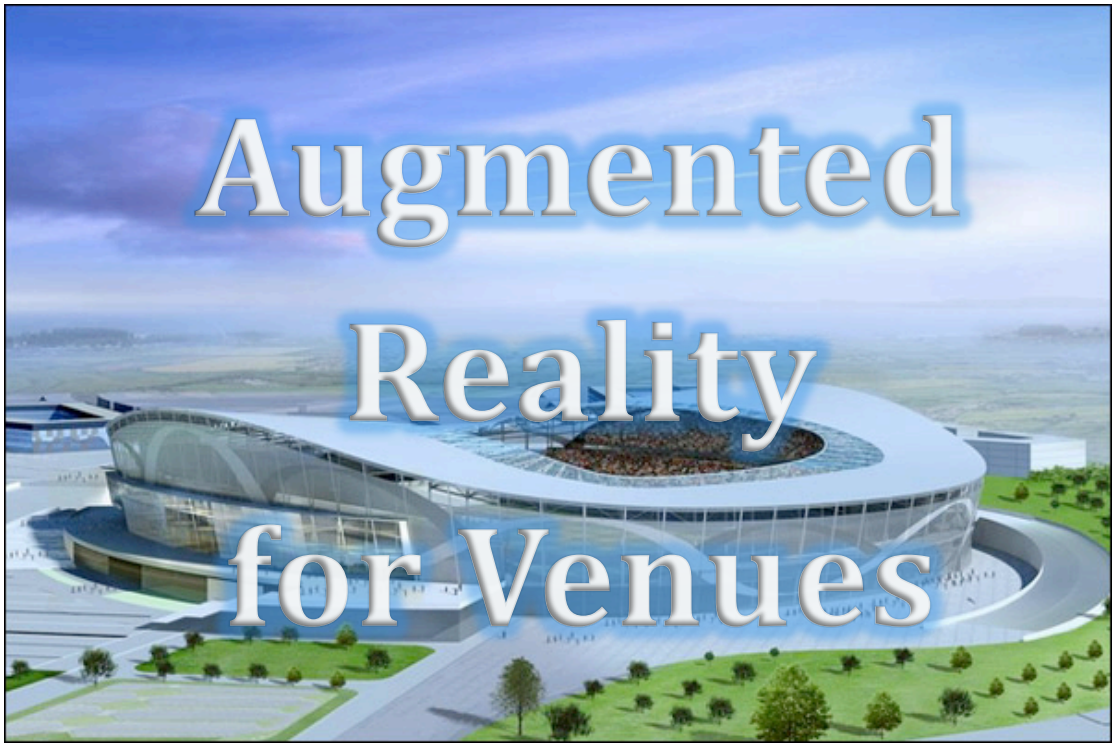

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Introduction

Mobile Augmented Reality is an ideal approach to enhance the experiences of visitors to venues. We begin with an explanation of how important it is for the operators of brick-and-mortar venues and businesses to stage "experiences" for those who they want to attract and to engage in profitable transactions. Our survey of different venue types allows us to compare their suitability and likelihood of adopting AR for visitor experiences or professional applications. We consider some of the possible needs that AR addresses and, by examining a few projects that have used AR for enriching the experiences of visitors or customers we identify some basic features of successful AR deployments for venues.

Experiences in Venues

For centuries, village people gathered in the marketplace or town square to learn from the itinerant merchant the news of the outside world or be entertained. Over the course of the 20th century, brick-and-mortar venues specialized and proliferated: shopping venues, sports venues, concert venues, exhibition venues, museums, airports and others have specialized services to offer the visitor. However, over the past decade, as the Web became an increasingly immersive, rich place to see, to learn, to shop and, with social media, to communicate and play with others, people are less and less seeing the need or the benefit of going to physical venues where they are separated from the information which they are accustomed to having at their fingertips.

Merchants and operators of venues seek to renew the traffic they once had or to expand their appeal to visitors by providing something unique, enjoyable or highly rewarding.

As Joe Pine III says in his groundbreaking work, “The Experience Economy”

> Businesses must orchestrate **memorable events** for their customers, and that memory itself becomes the product - the "experience". More advanced experience businesses can begin charging for the value of the "transformation" that an experience offers, e.g., as education offerings might do if they were able to participate in the value that is created by the educated individual. This is a natural progression in the value added by the business over and above its inputs.

In Pine’s view, memorable events –experiences—combine tangible and intangible. Feelings and emotions with facts, the décor, the distances. Reality with virtuality.

In an ideal venue, people—customers and visitors—will come to have and to share **experiences using digital (real time, accurate) information from sources they trust and they can get on the Internet, but that are integrated, added into/on top of the real world**. This is AR-4-Venues.

By combining the best of our abundant digital and physical assets, each individual will have a customized experience that they will be able to control, to recall at a later time, and to explore with others.

A short survey of venues

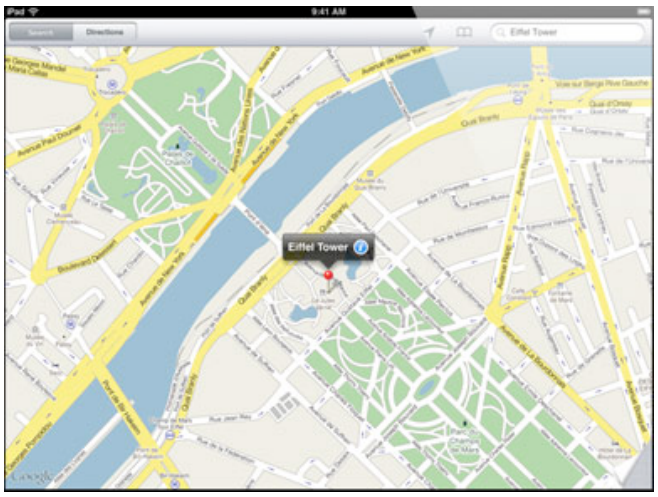
Venues are very diverse but can be classified for the purpose of considering their suitability for the development of Augmented Reality experiences. In this section, we consider the features of a venue that will make it likely that its owner or operator will benefit from AR for creating compelling experiences for visitors.

One of the characteristics to consider when classifying venues for AR suitability is their enclosures: are they indoor or outdoor? At present, consumer AR experiences are either driven by the results of computer vision associated with a planar surface (a marker or marker-less recognition) or those driven by GPS and compass that can be detected outdoors under favorable conditions (where there is satellite coverage and not in urban canyons). This distinction has been in place since the first smartphone AR examples over 4 years ago and with very few exceptions, the user cannot achieve AR experiences with the same application when indoor as when outd of doors. But the distinction is gradually breaking down with the aid of new positioning technologies and more powerful smartphones.

Another characteristic that we must consider is if a venue is designed for a single purpose or multi-purpose. Venues such as shopping malls are narrow in their scope. Airports are for travelers but these same people can also be customers for merchants within the airport. Is a fairground or exhibition space single or multi-purpose? For the owner of the venue, the purpose is to rent or lease the space for periodic events, and for its visitors, the purposes may be to hear a concert, see an art or cultural heritage exhibition or to conduct business meetings.

A multi-tenant venue has different requirements and must serve the needs of tenants differently. How are the AR experiences different within multi-tenant and single tenant venues?

The location of a venue is also important. A city center-venue is convenient for the inner-city residents, but not easily accessed by those who must drive cars from surrounding regions. A venue that is in a rural area is going to require a parking lot but can expand more easily into neighboring properties than can a venue in a city center. A venue on a lake or ocean shore has different appeal and flexibility than one inland or surrounded by urban development.



We can approach the question from a different angle and inventory the activities that people go to venues to achieve. Many activities people do or want to do in venues can be accommodated in flexible spaces.

- Museums or cultural heritage exhibitions come in all shapes and sizes and can be developed within virtually any space.
- Manufacturing venues have more requirements and probably have fewer options.
- Airports (Copenhagen) are among the most specialized venues as a result of the circulation of airplanes and the regulations and safety procedures for passengers and freight.
- Sports venues permit people to watch an athletic event. The same venue, if it consists of a field or stage either partly or completely surrounded by a structure designed to allow spectators to stand or sit and view the event, can accommodate other types of events (concerts, theater, political rallies).
- A music venue is any location used for a concert or musical performance. Music venues range in size and location, from an outdoor bandstand or a concert hall to an indoor sports stadium. Typically, different types of venues host different genres of music. Other attractions, such as performance art or social activities, may also be available in the same venue, either while music is playing or at other times. In fact, some classes of venues may play live music in the background, such as a performance on a grand piano in a restaurant.

- Meeting venues are numerous and also need to be sub-classified in order to find the best size/type for the use of AR.

Other considerations that could affect a venue's likelihood to use AR for producing experiences is the owner's financial and/or legal status, and the business model. Venues may be either privately or publicly funded, and may charge for admission. An example of a publicly funded venue is a park; such outdoor venues rarely charge for admission. A shopping center is commonly a privately-owned venue, and there is no charge for entering because the customers are expected to spend their money on goods or services sold.

Finally, a venue's wireless Internet and/or telecommunications infrastructure will also have an impact on its suitability for AR experiences. Venues in urban settings generally have better telecommunications services than rural ones. An airport is well suited to providing line of site services because there are many open spaces in boarding areas and concourses. Some venue operators have policies that prevent the use of WiFi, cameras or telephones, making the use of AR extremely difficult.

Benefits of AR for Venues

Nothing is successfully adopted if it does not serve the needs of multiple constituents repeatedly and reliably. Who are the stakeholders and what are their needs?

- First and foremost, the **visitors of venues** have requirements that, if not met, will prevent the venue owner or operator from attracting suitable numbers. What is the attraction? Based on the interests (music, sports, business, shopping, air travel, etc), the services offered using AR will differ. In a museum, the augmentations should provide interpretive materials in the visitor's language of choice. For a conference or exhibition on business topics, the AR user could search for businesses, or find out what is happening in a room, just by pointing the device in the room's direction. The content of the AR experience must excite and immerse the visitor without requiring extra steps, but most likely, this content only begins to get interesting once the visitor is at the venue. Getting to the venue is a process with which AR can certainly help as well: finding the best public transit route, an open parking place and then pedestrian navigation to the entrance of the venue.
- **Venue owners** want to maximize their profits and minimize their liabilities. That means that they want to commercialize special experiences or to support the businesses of the tenants in the venue. AR could be a way to promote special discounts offered by tenants. Or AR can help the visitor find the bathroom with the shortest line, the exit nearest to his or her seat, or the shortest taxi line.
- The **operators of events** such as exhibitions, concerts, festivals or sports competitions need to be able to engage directly with visitors by providing special offers (promotional messages) and also receiving feedback so that they can improve their experiences. Frequently, events can build loyalty by making it easy for people to find one another. Sorts fans in a stadium during half-time could more quickly find friends using an AR interface.
- **City administrative departments** and other surrounding businesses may also benefit from there being lower congestion around venues, higher business visits or more repeat visitors as a result of attractive experiences in a venue.
- The **providers of infrastructure** that uses AR, for example, providers of WiFi or 3G networks to a venue, or security and safety managers will also benefit from there being AR services available to visitors. They may insert updates regarding conditions outside, put promotional messages (sell advertising) or charge for data packages used by the visitors.

Mobile AR can help a businesses orchestrate memorable events for customers and visitors but it is clear that the benefits are not limited to the business and the visitor.

Real World Examples

There are already many examples of AR providing value to the visitors and owners/managers of venues. By examining a few in detail, we can develop some of the best practices that will emerge. In the current draft of this paper, we simply introduce three interesting projects:

1. Airport of Copenhagen
2. American Museum of Natural History
3. Wimbledon Tennis

In March 2011, the air transport IT provider of the Copenhagen Airport, SITA, enhanced its "CPH Airport", an iPhone application, with an Augmented Reality feature designed to help passengers navigate their way around the airport. By using an iPhone's camera to "scan" their surroundings, the app's augmented reality or "live view" mode illustrates points-of-interest in the terminal on-screen – such as check-in desks, shops, cafes, restaurants and gates and how far away they are. It also allows passengers to see how other users have rated the stores and dining establishments.

Due to the weakness of the GPS signal when indoors, passenger locations are determined using triangulation of the mobile signal power with respect to the airport's WiFi network.

SITA envisages upgrades to the application to offer passengers with information about the latest duty free promotions and real-time information ranging from the length of security queues, to which airport lounges are the busiest – helping passengers to make more informed choices.

The American Museum of Natural History in New York City released an AR-assisted application for iOS devices to help visitors get more value from the exhibition that opened on November 29, 2011.

Features include finding a spaceship that is bound for Mars, examining an asteroid that is approaching earth, and watching an elevator take off from the Moon. There's a total of 11 AR markers located throughout the exhibition that provide animations and social media features, such as image sharing via e-mail, Facebook and Twitter.

The IBM Seer application, introduced in 2009 for use at Wimbledon is probably the earliest application of this category. Running on Android, the application gives anyone in the stadium the ability to superimpose additional data about the match onto the court when viewed through the camera's lens. The Wimbledon Seer includes a locator function, match data, news feeds, information on refreshments, and can even tell you if the lines at a particular café, restaurant, taxi stand or bathroom are long.

Basic Features of an AR-4-Venues System

We believe that there are at least four basic requirements for a competitive AR experience solution for regular use in venues.

Navigation

Even if they have been to a venue before, visitors usually need guidance, navigational assistance, to find a place to park their automobile, to go directly to the counter where they can purchase or pick up their ticket or their assigned seat. In a shopping venue, the customers want to know where the products they want are located within the store and if there are any coupons or discounts offered by merchants.

Personalization

When the user logs into the AR experience, the server will immediately associate a record in the database with past experience uses and possibly gender, age and other relevant information.

Visitors want to be able to personalize or customize their experiences. This may require the platform to store the equivalent of bookmarks, or have connections with social networks, so that the visitor's friends and followers are visible in the AR experience or somehow provide a visitor the ability to recognize the faces of people who they have met before (built in face recognition).

Memory

Although very few examples of memory capture through an AR-assisted application exist today, we propose that having a route followed or another record of the visitor's experience will be a basic requirement of experiences provided to venue visitors. Like digital bread crumbs left in cyberspace, the memory function will help the visitor recall what they saw and did, and may also serve the operator of the venue to plan future improvements to a venue's exits, traffic patterns to the food or other facilities.

Transactions for Premium Services or Content

One of the best business models for AR experiences in venues is to charge the user an incremental feature or to purchase a product or service they've seen or learned about while using the AR experience. For this, there must be a built in transaction processing system.

Conclusion

Augmented Reality will be popular with the visitors of venues and can bring additional loyalty, engagement with a brand and revenues to the operator or owner of the venue. We predict that AR will become a standard feature of mobile applications created for special events and venues, however, many will fall short of visitor needs due to the fact that the smartphone's ability to precisely locate the position within a venue is low. Furthermore, we anticipate that visitors who travel across national borders and have only access to data services at roaming tariffs will be reluctant to use an application without knowing its impact on their bill upon returning home.

Despite these and other shortcomings in the near term, there will be many opportunities and benefits to visitors and the operators of events so solutions to challenges we face today will be developed by innovative companies focusing their technologies on the special features which AR can bring to venues. Stay tuned because this segment is going to expand!