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Beacon Location Based Augmented Reality Visualization of Smart Museum

[1] Dr. S. Muthusundari , [2.] V. Devi, [3.] Dr. R. Sujatha.

[1]Associate professor, Dept. of CSE, R.M.D. Engineering College, sms.cse@rmd.ac.in
[2]Assistant Professor (Sr.G), Department of Computer Applications, SRMIST, Ramapuram
[3]Principal, Subbalakshmi Lakshmipathy College of Science, Madurai

ABSTRACT

Internet of things basically makes virtually anything Smart, which means it upgrade each aspect of existence with the power of data collection, artificial intelligence algorithm and network. The augmented reality in which virtual content is flawlessly integrated with presentation of real world scenes, is a developing area of interactive design. A Museum is an institution that tends for collection of artifacts and different objects of artistic, cultural, historical or scientific importance and same open galleries make them accessible for public viewing through displays that may be permanent or temporary. This paper focuses on smart museum, which is one of the most significant beacon integrated and AR based museum. By using beacon the visitors do not have to do anything. The relevant content appear on the screen at the right place and time. In addition to the beacon the visitors can see different type of augmented reality content. The visitors can also view the environment into a virtual constructed vintage television. In virtual environment the visitors can move and look around easily. The beacon device provide information about the user location.

Keyword: Augmented Reality, Smart Museum, Beacon device, Internet of Things.

I. INTRODUCTION

AR is a technology that superimpose a user real world view with virtual text or image on the users viewing screen, monitor, helmet, facemask, glasses, goggles, windows, windshield, etc. in real time. Virtual image or text can be superimposed on chosen objects in the real world perspective of the user, where the virtual image or text is about the chosen object. Augmented reality is based on context aware computing. For an AR use the real world and Virtual Objects coexist on the same view. High Definition displays on smart devices enable sharp virtual text and images to be superimposed in an elegant and easy on the eye fashion.

The augmented reality is the most widely used technology among the digital convergence and changes the environment of human experience dramatically. This mixes reality with the virtual world, so the content could be known intuitively. Augmented reality technology makes people to experience the virtual world in reality, and it contributes to expanding intellectual capacity of human in different fields, such education, exhibition or tourism

Museum are informal learning institutions where entertainment and education are often combined. To this end, a various intuitive edutainment applications have been created throughout the years for conveying cultural information aiming to generate encourage and excitement active participation among people vising historical location and museum galleries. The most recent decade an increasing number of uses make utilization of mobile, location aware augmented reality (AR) advances which dynamically adjust virtual data to the physical displays on account of the learning of the user context. Such application range from mobile guides and instructive amusements to new media art and virtual exhibitions.

The launching of flexible operating system and software development environment such as the android platform for mobile devices and their acknowledgement by the mobile device producers and application designers, have triggered a quick increment in the utilization of smart gadgets such as smartphones and tablet computers. Smart devices features coordinate control interface, rich multimedia support, GPS navigation, flexible network, social networking and significant computational resources. Moreover, the new stages can be utilized on other electronic gadgets from laptops, notebooks and smart TVs to wearable devices overcoming existing cross-platform

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compatibility issues. As smart devices become a standard innovation, especially among young people, cultural institutions have endorsed mobile AR applications in order to museum visitors.

Together with the IoT vision, also the part of mobile and wearable gadgets is expanding. Mobile devices such as smartphones and tablets, are practically universal in our society, since they are not only communication means, additionally technological tools for controlling other gadgets and communicating data about clients. Hence, the pattern to utilize them for interacting with smart environment is progressively across the board. The cloud is a key technology in the digital world which play a role to store and share the data or information between the services and the users.

II. RELATED WORK

Fortino, G et al (2012) discussed in [6] about the suitability of the agent paradigm and technology to effectively support the development of an IoT based infrastructure and then proposed a multi-layered agent based architecture. The architecture as a wide variety of smart objects, from reactive to proactive, from small to very large, from stand alone to social.

Tsompanopoulou, P and Bozanis, P (2011) invented the iMuse Mobile Tour [5] which was a mobile museum guide that used a UHF (ultra-high frequency) RFID passive tag technology to provide the context-aware information services for the Archeological Museum of Volos (Greece). iPassive UHF RFID tags was installed to the museum showcases to exhibits the multimedia information. The system was implemented on a mobile devices using RFID terminal reader [5]. It comprises predefined and self-defined tours, as well as interactive games to stimulate learning. It supports multi-audience and multilingual content for tours. A distinguishing feature of this system was that it provided a services that enable the delivery of exhibit multimedia information to the users of a group on their individual mobile phones to encourage learning inside groups. This service was loaded via a web browser (without any software installation) and send the multimedia information to group member's individual devices. Groups are created through the iMuse Mobile handheld device with RFID [30], which acts as a group controller. As soon as group members connect their mobile devices to the wireless network of the museum and open the web browser, a page which automatically loaded all available services. Then, they can subscribe the webpage as a group's services by selecting their group's name. Each group subscriber was able to personalize their information presentation by changing his profile. Specifically, users can change the language and the audience type.

Fortino, G et al (2012) described in [6] about the suitability of the technology and agent paradigm to effectively support the development of multi-layered agent based architecture and an IoT based infrastructure. The architecture as a wide variety of smart objects, from reactive to proactive, from small to very large, from stand alone to social.

J. Wang et al (2012) proposed location aware lifestyle [10] improvement system to save energy in smart home. This system lets users who live in the smart-home be aware of wasted electricity, their life style and then improves their lifestyle. The system detect the various information such as user location and energy-usage of home electrical appliances. And then, the system acknowledge situation of energy wastage and provide services to improve the user's lifestyle.

Yu, Z et al (2008) explained a Context-awareness based on location is also the basis of the following systems. iMuseum [31] is a context-aware intelligent system that track the information about the visitor, recognizes their position and then help them while they are visiting the museum. Each visitor is given a PDA with applications: iGuide and iRecommender. When a visitor is interested in a cultural object nearby, the iGuide automatically provide the corresponding multimedia information of the cultural object on the visitor's PDA. The iRecommender which recommend related cultural relic that a visitor might be interested in after viewing some relics. The relics recommended are sorted by relevancy and suggested based on the user locations. The applications, running in the visitor's PDA, connect with a server, where the museum information are stored through a Wi-Fi network. The PDA is connected with an RFID reader that detect the location of the tags attached to the relics. The iMuseum prototype system was deployed in an exhibition room of an unspecified museum.

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Mehdi Mekni and Andr´e Lemieux described [] work performed in different application domains and explains the exiting issues encountered when building augmented reality applications considering the ergonomic and technical limitations of mobile devices.

Thomas Chatzidimitris in [] presened ARmuseum, an application developed for the Museum of Industrial Olive Oil Production in Lesvos (MBEL). Finally, it discusses a number of issues related to the evaluation of mobile AR applications for cultural institutions.

III. SMART MUSEUM AND ITS SERVICES

A. BEACONS: EXPLORING LOCATION-BASED TECHNOLOGY IN MUSEUM

The museum based on beacon technology that addresses the need for a low-cost, easy-to-implement solution for indoor location-based services. The service consists of three main element; 1). The beacon infrastructure which is installed on the museum periodically collect and sent the localization information of the museum visitor; 2). The service which run in the wearable device collect the landmark information to identify the location; 3). The service running on the processing center receive the location information about the user from the wearable device and provide it to the service. The beacon infrastructure installed individually in each rooms of the building. The embedded devices consists of the wireless landmark equipped with the beacon interface. The each Beacon infrastructure sent its location identification (ID) and the service running in the users wearable device collect the location information from all the landmark within the range and determine the room in which the artwork is located.

B. AUGMENTED REALITY

Augmented reality visualization can give extremely important bits of knowledge when connected in museum, not only for expert or initiated user but also for the non-expert or the first time visitor who has a difficulty imagining how a site could initially have resemble. The complexity of cultural heritage related information is moreover clear in the case of museum and other cultural heritage institution where the user regularly should know about the social, political, cultural, historical, economic or scientific related aspects in order to better approach and appreciate the exposed object. It is hence that historical center gives user with a wide variety of interpretation media – textual, visual or auditory and propose integral activities in order to help public explain the narratives revealed by the articles forming an exhibition. Multimedia and information technologies have been also utilized in this context in different forms among which fixed position Mixed and Augmented Reality establishments. Research, documentation and interpretation are among the missions of museums. Therefore there exist typically various types of resources and media that can be utilized to help the visitor approach the exposed object, a fact that would permit the Augmented Reality research community examine in depth the way different types of multimedia can be combined with Augmented Reality applications. This argument leads to the following one: Unlike other Augmented Reality applications, bound for the experienced in a particular domain user, museums are open to a wide public, of various ages and backgrounds, regularly with little or no knowledge in the use of computers. Therefore, if Augmented Reality is to reform the way we interact with computers, with the surrounding environment and with each other and endeavor in full the benefits regarding the potential social impact, museums seem to offer a perfect workspace for experimentations on that field. The design and execution of a successful prototype could then effortlessly be tailored to be used under comparable circumstances. As we will see in the following session, museums have also good reasons to support experimentations with Augmented Reality in their premises.

C. MOBILE GUIDES IN THE MUSEUM

Mobile guides, considered as one of the last relatives of computerized, refined audio guides, are turning out to be increasingly more popular throughout the world. Mobile guides present various point of interest as they stand in the cross section between multimedia and Information. All sort of media can be incorporated in mobile museum guides' applications in important approach to guide the user throughout the full visit. Moreover, mobile guides are able to be customized and taking advantage of localization service capabilities, deliver the correct information on the right place. Live streaming, bookmarking and communication possibilities are also key elements of mobile guides. In addition, museum expert can utilize the logs of visitors' activities to get significant data about the attracting and

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holding power of exposed objects and in addition about the way the interactive media resources are used. Regardless of the way that evaluation has proved these applications to be effective, some specific issues request further consideration: 1. the interaction surface is small and so selecting and controlling objects might prove to be a difficult task especially for the senior or for visitors not familiar with mobile technologies. 2. Localization service is a very helpful feature which locate the position of the user and sent the information to the user mobile device. In that case knowing the direction towards which the visitor is looking could be extremely helpful. 3. Creating links in between the digital counterpart and real world is another challenge. Difficulties in associating a museum object with the available digital resources could perturb museum visitors that get easily frustrated when it comes to complex in use information and communication systems.

Figure 1. Mobile museum guide

D. BEACON BASED AUGMENTED REALITY

Visiting a museum is no longer a one-sided, passive experience, as we've developed an interactive exhibition tablet app using the newest innovative mobile technologies: Beacons and Augmented Reality (AR) to convert static technical information into dynamic and interactive journey. As visitors walk around in the museum, and get close - within a meter, the wearable device capture the image and beacons will trigger various content of the captured image on the mobile device and automatically provide the descriptions, photos, videos and in some cases even 3 dimensional moving Augmented Reality (AR) models appear on the screen of the user device. With the app, we've developed a robust back end system with the accompanied CMS panel - so the staff of the museum can easily edit any data within the app - text, photo, video, eve the AR content and can add freely new beacons to the exhibition. There are different type of "trips" in the app for the different age, interest groups - meaning that kids can see different descriptions of the same object compared to adults. This solution of ours shows clearly how mobile apps with the latest innovative technologies can successfully serve the needs of any sectors in this case, museums.

Figure 2. Augmenting the real world with digital overlays

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IV. IMPLEMENTATION

As the scene that the visitor perceives is the video or the real scene of the surrounding environment augmented with computerized objects, it is very important to cater for a proper arrangement and registration of these last to the real world. Unfortunately and unlike virtual reality, in Augmented Reality even a little blunders are effectively seen by the human visual framework. Another very important factor is the combined latency, else called content delivery delay, meaning the delay form the time the estimations are taken to the time the images shown up in Augmented Reality display. Both of these factors are crucial to the acknowledgment and achievement of the system but unfortunately no current approach completely satisfies these requirements. A possible solution would be to combine Beacon and 3d model data. However for the time being Location based technology Beacon is the most vigorous and reliable and that is the explanation behind which it was chosen for this execution. In any case, the challenge is to receive the most proper solution in the more discrete and less obtrusive way for the museum visitor.

Early on, it was evident that the recent advances in low energy Bluetooth beacon technology provided an excellent opportunity to acquire an accurate estimation of the current position of a compatible smart device as well as the ability to act like a trigger for the desired functionality at that specific location. The app running on a smart device will alert the user when in the presence of a nearby beacon and provide instant access to the associated content. Smart museum system provide experience within the field of Augmented Reality (AR) and 3D-visualization made the utilization of these technologies a natural choice. This would additionally provide added value for the end users, making it possible to visualize large or fragile historical objects which would otherwise be unfeasible to exhibit. Additionally, objects not available at the premises in a physical form could be recreated in 3D and still give users a hands-on experience by interacting with a smart device.

V. CONCLUSION

This provided an interactive physics based animation for cultural heritage and provide an opportunity for the visitors to closely examine the 3D-model in an integrated model viewer. Furthermore, the museum uses beacon location tracking technology utilizing the location aware service, wearable device and smart devices. This system was responsible for customizing the 3D-model, creating textures and materials, as well as implementing the user position tracking features. A 3D-model visualizing the original half-timbered peak of a historical building was modelled from scratch, textured and introduced using an integrated 3D-viewer, thereby allowing the user to make a direct comparison when standing in front of the real building. In addition the smart museum also provide an additional information in the form of images, text and video clips provided the user with a proper historical context for each interactive location at the museum.

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