

Towards Enhancing User Experience through a Web-based Augmented Reality Museum

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Abstract—Museums act as a vehicle to collect, preserve and demonstrate historical, cultural and scientific heritage to a larger community of end users. However, there is neither increase in the number of physical visitors nor visitors to online museum, despite their availability on the web. On the other hand, Augmented Reality has emerged as a potential technology to support and enhance experience of end users in different communities especially in digital heritage. In this paper, we propose Augmented Reality Museum (ARM) as an application that can enhance online museum visitor experience. Augmented Reality can be integrated as a mobile application that provides 3D view of an artifact, along with information about its historic, artistic and/or scientific importance. We present the design and development of ARM and demonstrate it for the case study of Online British Museum. Our user experience study conducted with 21 volunteers shows that ARM is potentially a good way to enhance user experience.

Keywords— Augmented Reality; Museums; Web; Unity 3D

I. INTRODUCTION

Museums are considered to provide education and historical knowledge on a diversified range of artifacts to general public and they carry valuable information such as a nation's culture, identity, heritage [1]. There are several web interfaces designed for museums. However, there is need to provide an experience to users beyond the standard web interfaces that exist for cultural heritage [2]. It has been observed that visual learning aids in longer remembrance [3]. Existing techniques to render 3D models can be used to support museums. 3D models have been used to support museum exhibitions [4]. Visitors are provided with 3D models of artifacts displayed in museums and museum exhibitions [5]. In the context of museums, technologies such as NFC, RFID, QR code were used to improve ease of access to additional and existing contents of a museum and to facilitate visualization through virtual content [6] [7]. An interactive mobile application has been developed to teach children indigenous cultures of Cañari and Inca during their guided visits to museums [8].

Considering the fact that there is a significant increase in the number of online museum visitors [9] and existing technological enhancements, enabling museum websites with augmented reality is of a great importance [10]. An interactive Augmented Reality framework could therefore help in visualizing the website and thus help in preserving cultural heritage and also in attracting tourists [3]. Based on the lack of existing work on Augmented Reality for online museums, we propose ARM¹ as a prototype for museums that takes as input 3D

models and 2D artifacts present on the website to provide visualization to online museum visitors. It renders 3D models of various artifacts and objects of importance showcased in the museum website and also provides factual information about these artifacts, instead of scanning QR codes associated with them. These 3D models are displayed in the real space to the visitor and enables the visitor to interact with artifacts by zooming in, zooming out or rotating the 3D image displayed.

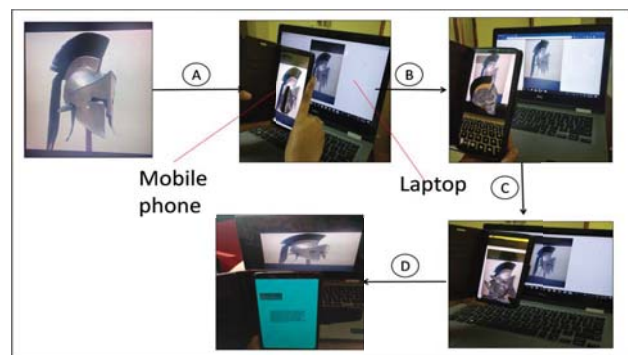


Fig. 1. Screenshots depicting the use of ARM

II. DEVELOPMENT OF ARM

The ARM application for mobile or tablet devices for a given museum's website takes 2D images of artifacts provided on online museum website along with their 3D models and their factual information as input and outputs a mobile application personalized to the museum. This app has been developed using *Vuforia Engine*² and *Unity3D*³ for Android platform. Figure 2 shows the approach followed during the development of ARM. We have primarily extracted few 3D models from *Sketchfab*⁴ for corresponding 2D artifacts provided on *British Museum*⁵ and created a database of 2D images with their corresponding 3D models and factual information. A user interface has been designed to serve as start screen of the application. We have then developed a script that helps to start device camera, process images of objects, identify the object, extract corresponding 3D model and factual information, render the model and display factual information. It also supports

²<https://www.vuforia.com>

³<https://unity.com>

⁴<https://sketchfab.com>

⁵<https://www.britishmuseum.org>

¹<https://github.com/AkhilaSriManasa/finalAR>

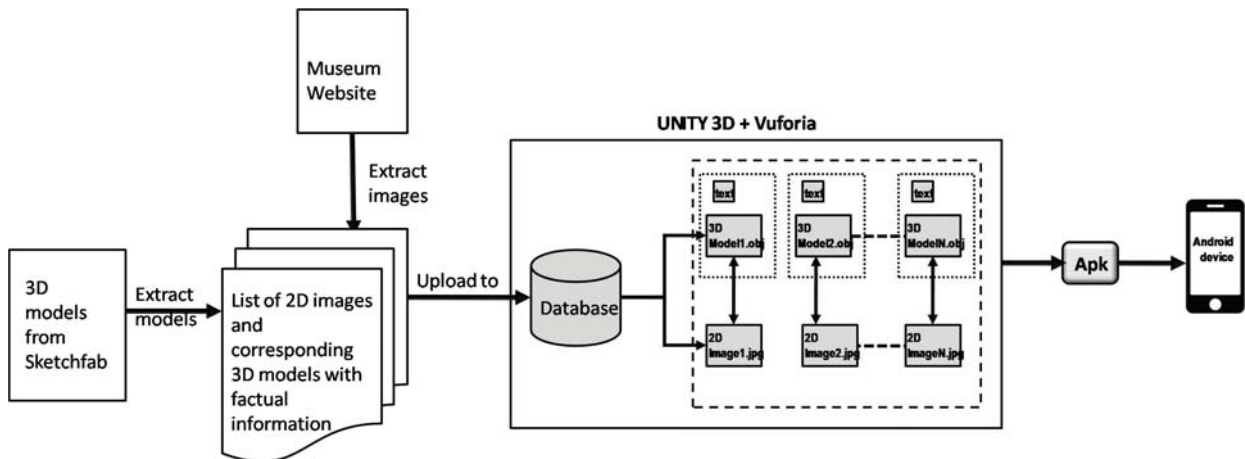


Fig. 2. Development approach

zoom-in , zoom-out, rotate options. The 3D model rendered is overlaid upon the existing 2D image focused by the camera.

Working of *ARM* application is depicted in Figure 1. When the device camera is focused on the image, a 3D model is rendered onto the device as shown in [A] of the Figure 1. This model can be zoomed-in, zoomed-out or rotated using two fingers as in [B] and [C] of Figure 1. A provision to view factual information is displayed as *info* option, that provides further details on the artifact as shown in [D] of Figure 1.

III. CONCLUSION AND FUTURE WORK

ARM has been introduced as a prototype to enhance the user experience of online museum visitors and aims to provide better and clear visual experience of various artifacts preserved in museums. As a future work, we wish to provide text-to-speech option that enables *ARM* application to read out the description of the artifact. We also aim to make *ARM* support various 2D images for which 3D models are not provided beforehand by exploring methods that could aid reconstruction of 3D models from 2D images. We plan to extend this application to support offline museum visitors. This could be done by finding out possibilities to obtain 3D models for corresponding 2D images of artifacts preserved in the museum, enabling the mobile application to be museum independent. We have evaluated *ARM* with 21 volunteers and about 84% of participants found that *ARM* provides better user experience and is informative.

One future direction that is both critical and interesting from a software engineering research perspective is to create a framework for generation of *ARM* applications for any museum. The input for this framework would be a website of any museum and its associated resources and the framework will parse the website, mine required images or information pertaining to the artifacts on the web and eventually create an AR app for the specific museum. Another direction is to leverage crowd-sourced approach for both validation of

generated AR app for museum as well as for users to upload relevant photos/images when they physically visit the museum.

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