Training Virtual Reality and Augmented Reality Prototyping without Coding

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Abstract
Recently, virtual reality (VR) and augmented reality (AR) applications have become popular. Hence, designers must be trained to be better equipped to design VR applications and games. However, current VR prototyping approaches present many obstacles to design students; for example, most applications require programming skills that involve a steep learning curve for design students without technical backgrounds. A VR/AR prototyping method that involves a gentle learning curve is thus required. This study proposed such a method, and conducted a 3-hour workshop with master-level design students. The outcome is reported in this paper. Observations and reflections are presented.

Author Keywords
Virtual Reality; Augmented Reality; Prototype; Prototyping; Design Methodology; Design Education; Interaction Design

ACM Classification Keywords
H.5.1. Multimedia Information Systems: Artificial, augmented, and virtual realities; H.5.2. User Interfaces: Prototyping

Introduction

Virtual reality (VR) and augmented reality (AR) have recently received considerable public attention. Hardware manufacturers have released customer-friendly VR/AR hardware such as the Oculus Rift and HTC Vive. However, it has been asserted in the mass media that more relevant VR/AR applications are required [5]. Training designers to become capable in designing VR/AR applications is necessary. Previous studies have attempted to simplify the process of creating VR content (e.g., [6]); however, such studies were not focused on prototyping. Existing VR/AR prototyping methods have limitations that are discussed subsequently.

Existing VR/AR Prototyping Approaches

Prototyping is crucial for designing interactive applications such as those involving VR/AR [3, 1]. A prototype helps designers illustrate their imagined applications. Prototyping is an essential skill for interaction design students.

VR and AR applications can be in different forms. The present paper primarily focuses on VR and AR applications which users wear head-mount displays to experience a virtual or augmented reality.

One common approach of prototyping for VR/AR applications is to create a prototype by developing a VR/AR application with reduced functionalities. VR/AR hardware manufacturers have released software development kit (SDK) packages and tutorial materials for developers to start developing applications for their corresponding hardware. Many SDKs support popular game development platforms such as Unity[1] and Unreal[2], which are supposed to reduce development efforts. However, scripting or programming skill is still required, and this is a large obstacle for students without technical backgrounds.

One may consider a paper prototyping approach [4] for VR/AR applications. Paper prototyping is suitable for producing prototypes for interactive applications that mainly involve flat screens such as desktop applications and mobile apps. However, creating a paper VR/AR prototype that offers an immersive experience similar to those of VR/AR applications is difficult, if not impossible.

One exception is a paper prototyping tool available online[3]. The tool receives an image, supposedly a sketch/wireframe of a VR/AR application, as input, and presents it as a curved wall showing the image in a virtual environment. The tool is web based and does not require scripting. Designers and users can experience an imagined VR/AR application (or the sketch of it). The drawback of this tool is that it only shows one image and does not illustrate different states of the user interface (UI). This tool served as an inspiration for the method proposed in this paper.

More Accessible Approach

This paper proposes a VR/AR prototyping method that requires basic skills that are common among design students.

[1] www.unity3d.com

[2] www.unrealengine.com

[3] http://vr.corindonders.nl/paper-prototyping-vr/

Skills and Hardware Requirements: Assumptions
Basic skills refer to abilities that most undergraduate and postgraduate students in design fields possess. It is assumed that the abilities for using photo-editing and slide preparation software constitute basic skills. In terms of hardware, it was intended that students can experience their VR/AR prototypes with hardware they already had. It was assumed that the students all had laptop/desktop computers and smartphones.

Design of Prototyping Tool

On the basis of the aforementioned two assumptions, a VR/AR prototyping method that requires basic skills of using Microsoft PowerPoint and smartphones is proposed.

Materials
Our method consists of a simple HTML file based on Web Graphics Library (WebGL) and a slideshow file (in PowerPoint format).

The slideshow file is a PowerPoint file with a reference grid image and number on each slide. Each slide is a wireframe of the UI of a VR/AR application in a given state.

The WebGL-based VR/AR slideshow is a primitive prototype that presents a slideshow of a series of static wireframes illustrating the appearance of the UI in different states. Each wireframe is shown wrapped around a sphere in the virtual space surrounding the user (the camera). Fig. 1 illustrates the mechanism. The HTML file is based on an A-Frame WebGL framework[4]. A "next" button hovering in front of the user brings up the next wireframe when triggered/clicked. Because the A-Frame WebGL framework works on smartphones, designers and users can experience the UI of the imagined VR/AR applications in different states by opening the slideshow in the web browser of a smartphone and putting it into a mobile VR viewer such as Google Cardboard.

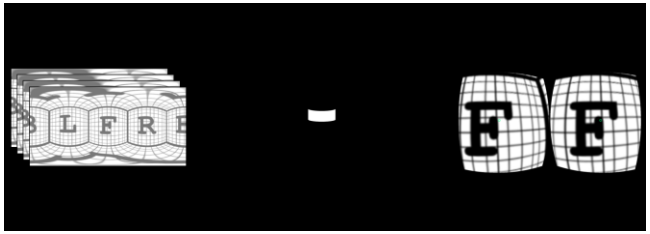

Figure 1: A set of wireframes are wrapped around the user's point of view. Two-dimensional images become a VR/AR prototype that designers and users can experience with smartphones.

Steps to Create a VR/AR Prototype
First, a designer must open the slideshow file and edit each slide to illustrate different states of the envisioned VR/AR application. Subsequently, each slide in the file is exported to individual image files. The image files are used to replace the set of image files being referred by the HTML file in the VR/AR slideshow. The HTML file can then be shown in a web browser (e.g., Mozilla Firefox). The designer can test the VR/AR prototype by turning with the mouse to drag the browser window. The designer can then test the prototype on a mobile device. There is no straightforward method for transferring to and viewing a set of HTML and image

[4] aframe.io

Figure 2: AR Prototype demo shown to the students during the workshop. It illustrates an AR application that guides the user to a building on a university campus.

Figure 3: A student from group 1 presenting their VR prototype. Genres are surrounding the user.

files on a smartphone. The designer must upload the set to a web server and open the HTML file in the web browser on a smartphone. This is potentially a technical challenge for some design students. Therefore, simple steps are illustrated in a tutorial of this prototyping method.

Prototyping for VR and AR

One similarity between prototyping for VR and AR applications is that both kinds of prototypes are simulating panoramic experiences. The panoramic view of the slides in a mobile VR viewer serve this purpose.

VR applications may involve objects that do not exist in the real world. With the current approach, prototyping for VR requires more materials to set up the basic environment. Designers needs to create artificial elements to set it the basis of the virtual environment.

AR prototypes involves appearances or representations of the real world. With the current approach, prototyping for AR requires panoramic images to be inserted to represent the real world. One option is 360-degree panoramic images taken with Google Street View app which is accessible to students with modern smartphones. The static panoramic image can represent a panoramic view of the reality. Designers can focus on additional elements that augment the reality and the interactions.

Workshop

To further explore the proposed VR/AR prototyping method, a 3-hour workshop was conducted with a class of 17 master-level students majoring in interaction design. The students were from a diverse range of academic backgrounds including engineering, computer science, design, and journalism. First, a 30-minute lecture was given to the class to introduce the new VR/AR prototyping method. The class members were asked to use their smartphones to visit a URL presenting an AR demo created using the new prototyping method (Fig. 2). The lecture also included a step-by-step demonstration of how to upload a set of HTML and image files to a web host service[5] by using its web-based UI. Subsequently, the students formed four groups, each with four or five students. Each group was given the minor task of designing a VR/AR application for a music streaming service that would enable users to browse and listen to music in a relaxed manner. The groups were given 2 hours to work on the task while the author provided assistance. The purpose of this hands-on activity was to help the students become familiar with the method and to encourage creativity [2]. The groups were able to create prototypes and upload them to web hosts to enable them to experience their prototypes on their smartphones.

Finally, after creating a prototype, each group presented it to the class.

Student Works

The four prototypes are described as follows. The groups are labeled as groups 1, 2, 3, and 4.

Group 1's design contains four screens. First, genres surround the user (Fig. 3), who can browse them by turning his or her head. After a genre is chosen, playlists belonging to that genre are presented

[5] www.000webhost.com

Figure 4: A student from group 2 presenting their VR prototype. Other users' comments regarding the current song are shown "above" the user.

Figure 5: A student from group 3 presenting their VR prototype. The picture shows one of the buttons.

Figure 6: A student from group 4 presenting their VR prototype. The picture shows the welcome screen.

horizontally. When a playlist is chosen, the songs are presented as a horizontal list. When the playlist is played, music control buttons (i.e., play, pause, and stop) appear.

Group 2's design contains two screens. The first screen is a 360° music video with basic music controls at the bottom and a list of songs above. In case a song is not associated with a music video, the second screen presents the lyrics of the song. The UI highlights the current line of lyrics (similar to a karaoke video). Other users' comments are presented above the lyrics (Fig. 4).

Group 3's design contains four screens. First, a home screen shows "Recommendations" and "Radio Streaming" options. When Recommendations is chosen, the second screen shows recommended albums in a grid surrounding the user. The third screen displays the songs in the chosen album. The final screen shows the UI when a user is playing a song, including the song title, music controls, lyrics, and a circular process bar. Some UI elements were observed to be very large (Fig. 5), which the students realized when they experienced the prototype on their smartphones.

Group 4's design contains four screens. First, a welcome screen showing a "Let's Begin" button and an audience surrounding the user appears (Fig. 6), thereby enabling the user to feel as though he or she is at a live concert. When the "Let's Begin" button is selected, the second screen shows albums in a grid surrounding the user. The third screen shows the next page of the album grid, and the final screen displays the visual effects when a song is being played.

Observations and Reflections

Difficult to Refer to VR/AR Examples

VR/AR prototypes are supposed to be experienced with full immersion. During the workshop, the author was trying to refer to a point in the demo AR prototype. Because the students were immersed into the demo, the author had to verbally tell the students where to look. It was difficult to gain their attention at the same time.

Referencing Existing Two-Dimensional (2D) UI

Group 1 referenced the web UI of an existing music streaming service. They captured screenshots to use as the basis for their prototype. The image-based method of the proposed prototyping approach enabled them to use existing references easily, even 2D ones.

Distorted UI Elements

Some UI elements in the designs of groups 2 and 3 were observed to be heavily distorted. After the session, the students in group 3 said that they realized this mistake when they tried the prototype on their smartphones. One possible explanation is that the students did not manage to imagine how the elements would appear in the VR/AR prototype tool when they were creating the slides. The tool applies each slide to a sphere surrounding the user in a 3D virtual space. Therefore, it stretches the slides and scales up all the elements. One lesson learned from this observation is that the students can try their UI on their smartphone more frequently during the design process, which may help them detect scaling and distortion issues early. Also, they can build up the ability to imagine the form of the final prototype. Another lesson is that the current prototyping approach is lacking immediate feedback because the designers need to work on a 2D canvas but cannot see how the canvas look like in a VR/AR. A

what-you-see-is-what-you-get (WYSIWYG) approach may solve this problem.

Expression of Innovative Ideas
In group 2's design, the appearance of other users' comments regarding songs is an innovative feature. This group managed to express this with their prototype. The welcome screen of group 4's design displays a concert venue. They made use of the immersive properties of VR and attempted to let the user feel as though he or she is at a live concert. This group managed to express this with their prototype. Allowing students to create their own VR prototypes appeared to encourage them to be creative and explore various possibilities for VR technologies [1].

Tendency to Create Flat UI Elements
In all groups, the UI elements were flat panels hovering in virtual spaces. None of the groups attempted to include three-dimensional (3D) objects such as cubes or spheres available in PowerPoint in their designs. This may be because the proposed prototyping method is based on images. This is a potential limitation of the new method; it may not be suitable for VR/AR applications with complex 3D environments such as VR games. Another possible reason is that the students were too focused on the 2D elements they normally use for making presentations slides. The author could have remind them about those 3D elements in the instructions and demo prototype.

Conclusion
A new prototype method that involves a gentle learning curve is proposed. A workshop was conducted with master-level design students. According to the students' works, the new method and 3-hour workshop enabled them to create VR prototypes that could realize their ideas. More relevant tools and training are required to fulfill the growing need for designers capable of designing VR/AR applications.

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