

Towards a Workflow and Interaction Framework for Virtual Aquaria

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Figure 1: The virtual aquarium system.

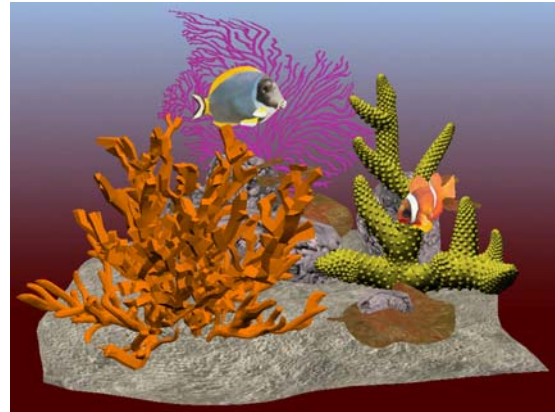


Figure 2: Example scene from the virtual aquarium.

1. Introduction

Modern day science museums have embraced the idea of using highly interactive exhibits to attract, involve and engage their visitors. Zoos and aquaria however suffer from the problem that direct interaction with animals and plants is not always desirable. While the interest of visitors in interacting with specimens is evident in the popularity of touch-tanks and petting-pens, visitors must be protected from the specimens, and vice versa. The question therefore is how do you introduce the benefits that interaction has produced in science museum to institutions that display living specimens and direct interaction is not possible.

In this paper we present a system and workflow for building interactive aquarium exhibits based on virtual and augmented reality displays, wireless devices as information and interaction tools, and a content creation process for the designer not the technician.

Imagine entering an aquarium. You are given a set of glasses with instructions to only wear them when looking at the aquaria. You're provided with a PDA that you operate with your finger. You enter some information regarding your age, background and interests. When you approach an aquarium you notice that the graphic panel above the tank and the kiosk in front of the tank display the same information and you can change the information by touching the kiosk. Your PDA also connects wirelessly to the aquarium and kiosk and displays information about the creatures on display.

The PDA offers you a choice of information about the creatures you can see. You touch the pictures of the fish and coral on the PDA and information appears on the PDA and graphics panel. You can also play animations that show different behaviours and processes. How do fish

float? How do coral grow? When you choose the animation you wish to play, the real aquarium is dimmed and a virtual aquarium appears in its place. The coral start to bloom. The fish become transparent and you can see their flotation bladders. After returning home you access the aquarium's website, review the personalized information you gathered during the visit, and start to plan your next trip.

In the following sections we describe a virtual and augmented reality system built to achieve this scenario. The Virtual Aquarium (c.f. Figure 1) is designed on the Virtual Showcase® [3], which has a perfect form for an aquarium or terrarium display. The information and interaction system is based on Personal-Interfaces-to-Go (PI2Go®) [4]. The workflow we have designed for content creation uses industry standard 3D modelling software such as 3D StudioMax®, and in the near future Maya®. Essentially what we have constructed is a WYSIWYG tool for any Virtual Showcase application. Currently the Virtual Aquarium includes only virtual elements and in the near future will include augmentation of virtual content on and around physical coral.

2. The Display System

The Virtual Showcase [3] (c.f. Figure 1) is an optical see-through augmented reality display that allows multiple users to observe and interact with the augmented physical content [2]. It exists in a number of configurations and we have identified a design proven to be cost effective and suitable for an exhibition setting. The pricing for each unit has been estimated at between \$10,000 and \$15,000.

For a public display, the underlying hardware must be as robust and reliable as possible with all delicate and potentially harmful equipment out of reach of the visitor. Risk is not only presented to the visitor by possible physical

harm via electric shock or abrasion, or effects such as cyber sickness, but also equipment acting as a medium for infection, especially when worn on the face and passed between visitors. Therefore while the stereographic display system has been prototyped on a Virtual Table® system, which uses a Barco Baron® table and CrystallEyes® shutter glasses, the configuration we will use in an exhibition is based on a passive stereo system, such as StereoGraphics' Monitor zScreen 2000/2000i®. A passive stereo system is preferred as the glasses are easier to clean and often inexpensive enough to provide as a souvenir to the visitor.

Head tracking will be performed via a low cost optical tracking system such as the Origin DynaSight®, where the limited range of such a system is an advantage if many displays are part of the exhibition. The rendering system is based on commodity personal computers with high-end programmable graphics cards.

3. Interaction System

To compensate for the relatively low potential for interactivity, zoos and aquaria use sophisticated presentation techniques for their specimens. However the presentation of information regarding their specimens is often rudimentary. Graphic panels are static and can be difficult to understand if there are differences between the example images and the specimens. The specimens can also be difficult to find when camouflaged by their surroundings. Even being able to read the panel can be difficult if visitors heavily populate the exhibition.

Our personal information and interaction system is based on the Personal-Interfaces-to-Go (PI2Go) system, which was originally designed to transfer visualization contexts between distributed heterogeneous visualization suites, from high-end VR systems to desktop personal computers. It also acts as a common interface between the visualization systems allowing scientists and medical practitioners a simple and easy-to-learn control device.

In the aquarium setting, the PDA will act as a personal guide, information panel, data store and interaction device. The device registers on approach to an aquarium display via an infrared emitter (IrDA Beacon). The information presented and the learning experience can therefore be tailored based on the visitor's preferences and profile and the specimens that exist in the display. The PDA and kiosk also play the role of interaction tool providing a simple, familiar and consistent interface for controlling animations and different states of the system.

The interfaces are designed using Macromedia's FlashMX®, therefore GUI programming is not required. Communication between the interaction device and aquarium display is implemented using SOAP and XML based protocols.

4. Workflow Design

To engage visitors of different age groups, cultures and interests, non-linear stories and interactions are an important tool, especially if the exhibition wishes to attract the visitor back repeatedly. However in VR systems, content typically has to be defined using a system specific e.g. scripting language [5]. Our goal is to use standard modelling and animation tools such as 3D

StudioMax® and Maya® and to build a truly WYSIWYG modelling and animation system.

Because the rendering system is based on a personal computer and a highend nVidia graphics card, we use nVidia's CgFX plugin for 3d Studio Max® and Maya® to preview aquarium scenes in real-time and as they will appear in the display. The final content is then exported to a portable format, nVidia Binary (nvb), for which a renderer has been integrated into the Virtual Showcase viewer.

5. Conclusions and Future Work

We currently have prototyped a purely virtual version of an aquarium setting using the Virtual Showcase. We have identified an existing hardware configuration that will accommodate a large number of visitors moving through an exhibition space comprising a number of smaller aquariums. The Virtual Aquarium will be developed further into an augmented reality system. The physical objects will initially be prosthetic corals, which can be artificially shaded and populated with virtual fish. Introducing virtual elements into a living aquarium poses the only major unsolved technical difficulty. The water filling the aquarium will affect the light from the projectors used to generate the occlusion shadows [1]. We believe a configuration can be devised to facilitate occlusion shadows.

The workflow we have built allows designers to create and view their final content in real-time using industry standard modelling tools. Limitations however exist on the type of bones structures that can be used for animation, as the only exporter available is non-standard prototype and not supported. One aspect of our future work will be to remedy this situation.

The information and interaction system is based on the PI2Go system, which has been proven in similar exhibition systems. Interface design for the interaction system is also performed using a tool familiar to most designers.

References

1. Bimber, O., Fröhlich, B. *Occlusion Shadows: Using Projected Light to Generate Realistic Occlusion Effects for View-Dependent Optical See-Through Displays*, In proc. of Int. Sym. on Mixed and Augmented Reality (ISMAR'02), pp. 186-195, 2002.
2. Bimber, O., Gatesy, S.M., Witmer, L.M., Raskar, R., Encarnação, L.M. *Merging Fossil Specimens with Computer-Generated Information*, IEEE Computer, pp. 45-50, 2002
3. Bimber, O., Fröhlich, B., Schmalstieg, D., Encarnação, L.M. *The Virtual Showcase*, IEEE CG&A, 21(6): 48-55, 2001.
4. Tesch, J., Dietze, L., Encarnação, L.M.: *Personal Interfaces-To-Go: Mobile Devices for Data Exchange and Interaction in Heterogeneous Visualization Environment*, IEEE Int. Conf. on Distributed Computing Systems (ICDCS'03), pp. 290-293, 2003.
5. Bierbaum, A., Just, C., Hartling, P., Meinert, K., Baker, A., Cruz-Neira, C. *VR Juggler: A Virtual Platform for Virtual Reality Application Development*, IEEE VR, pp. 89-96, 2001.