Novel Audio Interface Design for an Interactive Mixed-Reality Museum Exhibit

Jon Friskics

Digital Media Department, University of Central Florida
P.O. Box 163121
Orlando, FL 32816
United States of America
jfriskic@mail.ucf.edu

I. Introduction

In the Fall 2009 semester, the graduate-level Applied Interactive Story course at the University of Central Florida designed and prototyped an interactive museum exhibit for a proposed NSF grant entitled "Dancing The Earth." The general purpose of this exhibit is to teach museum visitors about some aspect of an ecosystem in the Everglades, and our specific scenario focused on feeding habits of the wood stork. Planning for such a large project required specialized research in the areas of interactive storytelling, level design, environmental design, character modeling, volunteer training, educational assessment techniques, video and sound design, and interface design. The class pooled together their respective strengths, and by the end of the semester had completed a process called "play testing" multiple times. I chose to focus on sound design and audio system design because of my prior experience in the field, and by the end of the semester I developed a novel touch screen interface for remote audio control of the exhibit.

II. Problem and Background

The core of the exhibit relies on remote control of the active scenario by a museum volunteer that is located away from the museum. Using a single volunteer to control the exhibit, and placing that volunteer so far away from the museum presents several large problems, the most significant of which are listed and described below:

1) Bandwidth - real-time audio streaming from the volunteer to the museum is infeasible due to the normal ratio of bandwidth needed to bandwidth available.
2) Information overload - since the volunteer will need to give attention to multiple screens/interfaces, anything more than simple control will be information overload, and is likely to cause fatigue.
3) Feedback Loops - since the volunteer needs to communicate with people in the exhibit, and the people in the exhibit need to communicate with the volunteer, the potential for feedback loops must not be ignored.
4) Troubleshooting - if something goes wrong on either end, the experience gets very quiet very quickly.

For the sake of scope and clarity, the rest of this paper assumes that audio and sound are the only elements under consideration, and that story-writing, video interface development, and volunteer training have been handled by external forces.

III. Interface Mockups + Background

In the course of pre-production, three distinct interfaces were planned for remote museum volunteer control of the exhibit audio systems. For each of these interfaces, it is assumed that the volunteer will be given all of the technology in a turnkey system that they can simply un-box, plug-in, and be ready to run with minimal setup and configuration. It also needs to be assumed that the systems will have the ability to reset all preference files and system configuration files on reboot, so as to minimize the chance of an unrecoverable error caused by a human mistake. The work of usability designer Stephen Few was

consulted for inspiration into the interface design. Few writes "The information must fit on a single screen, entirely available within the viewer's eye span so it can all be seen at once, at a glance," [1] so all of the interfaces discussed below are envisioned as fitting on a single screen. Few also outlines 13 common mistakes in dashboard design, including "3) Displaying excessive detail or precision, 10) Highlighting important data ineffectively or not at all, and 11) Cluttering the display with useless decoration," [1] and these rules have received much consideration in the design of the interfaces.

Reeves cites Oviatt and Stanney and suggests "cognitive science literature on intersensory perception and intermodal coordination has provided a foundation for determining multimodal design principles… and to optimize human performance in multimodal systems, such principles can be used to direct the design of information presented to users, specifically regarding how to integrate multiple modalities… such as voice and gesture." [3] This suggests that further advice should be sought from experts trained in cognitive psychology to fully explore all of the issues surrounding this type of interface design.

The minimum diagonal screen size of the audio interface should be 20" with a resolution of at least 1280x1024, and the screen should support multi-touch control. The three interfaces are presented and discussed below in the order that they were developed.

IIIa. Interface 1 - "Scales"

Description

Scales features a 7x7 grid of angular boxes (called scales because they looked like scales on a reptile after I drew them on a large sheet of paper) that display information about currently loaded audio files. The scales can be configured through software to show information, and the idea was that they would be available in four preset configurations:

1) Sound effect playback
2) Music playback
3) Preset dialogue playback
4) Push-to-talk

A single scale located at the origin of the grid (row 1, column 1), would serve as a system menu to select between exhibit scenarios, and the bottom-right scale contains a push-to-talk button that will activate volunteer-exhibit microphone communication only when that scale is held down. Loading a new scenario would pre-fill the remaining 47 scales with a combination of sound effects, music, and dialogue presets. Each normal scale's display would contain latch controls for play and stop, a momentary switch to solo the audio triggered by that scale, and a draggable volume fader.

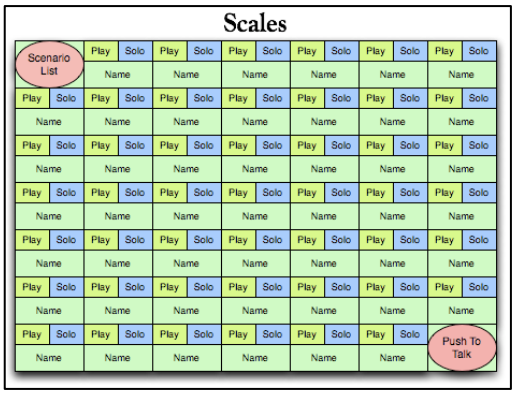

Figure 1 – *The "Scales" Interface Mockup*

Pros and Cons

The biggest feature that Scales offers in terms of interface design is the ability to have all information displayed at all times AND be accessible to the operator at all times. The downside to this approach is, of course, great potential for information overload. Another question considered was "does the operator need to have full control of dialogue, music, and effects?" When we asked this question and attempted to write down a comprehensive list of all sounds that would need to be manually triggered (not automatically triggered), we realized that the operator will most likely need to be able to switch scenarios that contain sets of pre-scripted sounds driven by exhibit triggers, and not need the level of control that the Scales interface offers. If this is assumed to be true, then Scales amounts to

a lot of wasted screen space and unnecessary clutter.

IIIb. Interface 2 - "The Flag"

Description

The Flag borrows from the iconic American flag metaphor with the hope that operators will be so used to the layout of the flag that they will have no trouble locating information once they are acclimated to the type of information that the stars and stripes sections contain. The stripes are each clickable bars that will cause a specific scenario to load, and the scenarios are ordered 1-13 from top to bottom. The currently loaded scenario will be highlighted in contrast to the other scenarios so that it is immediately obvious which scenario is active. The stars section will contain a screen that shows relevant information about the currently loaded scenario such as current position vs. duration of cues, overall volume, and the ubiquitous push-to-talk button.

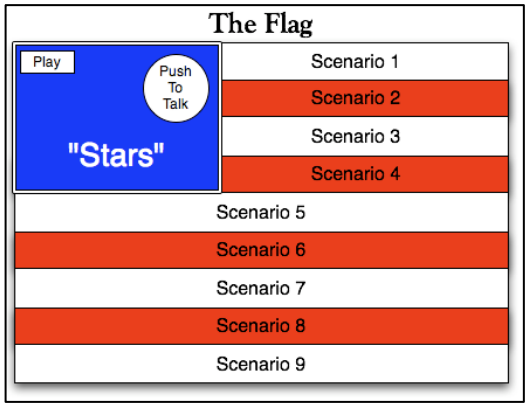

Figure 2 – *"The Flag" Interface Mockup*

Pros and Cons

The idea behind The Flag is that it improves on a number of shortcomings of Scales. Since Scales displayed so much unnecessary information across multiple tiny panels, The Flag removes all of those tiny panels and presents the operator with one single display window at the top-left corner of the screen. It is assumed that the stars window will be anywhere from 1/3 to 1/2 the width/height of the display. Another thing that makes this interface unique is that the operator can instantly tell how far along in the sequence of scenarios the exhibit has progressed. A downside to this interface is that the stars window can only display information from one scenario at a time, and there is no way to "look ahead" to sounds in a future scenario (although arguably this feature is not necessary).

IIIc. Interface 3 - "Wheel of Sound"

Description

The Wheel of Sound is a series of concentric circles emanating from a single center circle. The spacing between each circle is large enough to display important contextual information about what that ring does, but is also small enough so as to not waste space. The idea is that the most used sound features would be accessible from the singular center circle, while less used features would be accessible from the outer rings of the "solar system" of circles. It was decided that the most used feature would likely be push-to-talk mode, and that this should occupy 100% of the space of the inner circle. The first ring would contain cross sections assigned to music cues, while the second ring would contain sound effects, and the third would contain dialogue. The beauty of this system is that ranges of the 360-degree pie would be confined to sounds from a specific scenario, and the selected wedge (scenario) of the pie would be highlighted in contrast to the other wedges. It is not expected that the operator will need to control individual volumes or playback of any of the specific sound effects for reasons discussed above in the descriptions of previous interface mockups, but it is desirable that the volunteer be able to see what sounds are possibly going to play in a specific scenario. It is this subtle interface design that allows for information about all scenarios to be visible at once, but through creative use of the "highlighted wedge", the information overload overhead associated with showing that much information at once will be greatly reduced. Other than hitting the push-to-talk button, the operator will only need to potentially select a new wedge to trigger the start of a new scenario early or

later than anticipated due to variations in audience participation/comprehension etc.

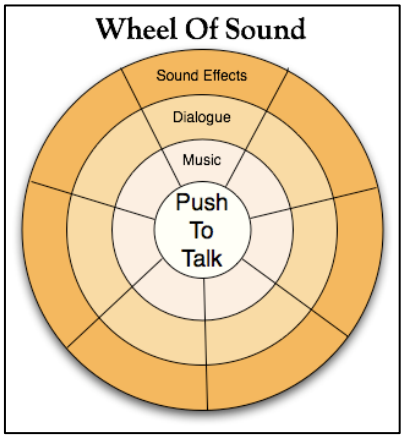

Figure 3 – *The "Wheel of Sound" Interface Mockup*

Pros and Cons

In addition to the unique interface tweaks discussed above, we anticipate that this interface will be the most intuitive for both non-trained operators and our key volunteer demographic of a potentially older generation that doesn't have intuitive experience reading touch screen interfaces. For the exhibit as defined this semester, we were hard pressed to find any disadvantages to this interface design short of wasting some corner screen space due to the circular nature of the interface paired with the rectangular physical construction of the touch screen monitor.

IV. Summary and Recommendations

Figure 4 identifies a number of key metrics that naturally evolved from the information above mapped across each of the three interfaces to create an "interface comparison" list. From this presentation, it appears that the Wheel of Sound is the most appropriate of the three interfaces to consider for implementation into a full remote volunteer control system. It would be beneficial for the interface programming team to work with an interface designer on issues such as typography, color palette, and resolution of each of the interface elements, but for the most part the Wheel of Sound mockup explains enough about its implementation to start developing it immediately.

Interface	Pros	Cons
Scales	- Lots of elements in one place	- Information overload - Unnecessary controls
The Flag	- Display of only active elements - Scenario progression visible	- Still too much control
Wheel of Sound	- Active scenario shows up - Scenario progression visible - Simple	- Less control, but also less overload!

Figure 4 – *Comparison of the key features of all three interfaces.*

Another issue that has not received enough attention is the process of usability testing. Interface developers should plan to engage in a complete user experience study, from generating personas and use-case scenarios, to conducting focus groups. When conducting tests with novel interfaces, it is important to follow some of the tenets that Spolsky set forth, like "When you sit somebody down in a typical usability test, you're really testing how *learnable* your interface is, not how *usable* it is." [3]

V. References

[1] Few, S, *Information Dashboard Design: The Effective Visual Communication of Data.* Sebastopol, CA: O'Reilly, 2006.

[2] Reeves, L. "Optimizing The Design Of Multimodal User Interfaces," Ph.D. thesis, University of Central Florida, Orlando, FL, 2007.

[3] Spolsky, J, *User Interface Design for Programmers.* New York, NY: Apress, 2001.