Designing the Public Interface

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Abstract

In the age of mega lawsuits over ownership of computer interface metaphors little time is spent on an issue critical to successful interactive museum exhibits - the "public interface". A public interface which is responsive to a general audience is a key to the museum visitor's exploration of interactive exhibits and can foster a positive response to the application of learning technologies in museum environments. In contrast to interface designs for standard operating systems and applications software, the primary focus of a public interface is to: quickly engage the casual visitor, demonstrate the use of the exhibit, and facilitate their informal learning experiences. Based upon experience in the design of interactive science education exhibits, the author identifies and discusses key interface design issues including: navigation and content structures, formative evaluation, appropriate application of media, multi-disciplinary design teams, input controllers, and hardware issues.

Introduction

Museums are frequently viewed as consumers of software and computer technologies. Recently a new trend is emerging - that of the museum as a software developer or development partner. This trend is partially due to the desire of museums to make interactive software-based exhibits which reflect the needs and desires of their particular museum and its audience. Broad public usage of interactive exhibits necessitates new questions in the museum environment:

- how does the visitor interact with these new exhibit forms?
- do they replace other types of exhibits or displays?
- how does a museum go about designing an interactive exhibit?

- how can these exhibits be evaluated?
- who will use them?
- can these exhibits be made in-house ?

The focus of this paper is the design of computer based exhibits which directly engage the museum visitor, and the mechanisms which allow the user easy access to the information - the "public interface". Design principals of interactive exhibits have similar underpinnings despite the various uses museums put them to: as information kiosks, orientation systems, electronic titles, electronic learning centers, etc. Without clear design principals museum politics are liable to replace the design and evaluation process. The design of an interactive exhibit necessitates the integration of numerous skills and points of view (usually dispersed amongst competing departments) and the formation of an interdisciplinary design team.

Interface Mechanics

In order to attract and sustain the public's attention, an interactive exhibit needs to: quickly engage the casual visitor, demonstrate how to use the exhibit, and be a cooperative partner in the visitor's informal learning experience. To facilitate these goals the exhibits need a close integration of the content structures and the interface mechanisms used to explore it. The mechanics of a public interface include:

- visual elements (screen layouts w/ graphic windows)
- sound elements (sound effects, narration, and music)
- screen controllers (on-screen buttons, switches, knobs, etc.)
- mechanical controllers (buttons, knobs, joysticks, mice, trackballs, touch screens)
- text elements (titles, content narrative)

The combination of these elements in a public interface requires the integration of fairly disparate disciplines, and can potentially offer museums new forms of exhibits.

Interface Criteria

A public interface has unique considerations which differentiate it from the better known interfaces used on the Macintosh operating system or Windows on the PC, or other platforms. Public interfaces have a stringent premise - the user only has between ten seconds to a few minutes to figure out how to use the application. Your typical computer interface presumes that the user will spend as much time as necessary to face the "learning curve" for the desired application. Design considerations for the "public interface" used in the museum environment include:

- general lack of computer literacy
- limited interaction time
- tailoring for multiple age levels

- varied reading skills
- subject matter complexity
- consistency of user interface across multiple applications
- information overload
- sonic and visual environment surrounding exhibit

The primary criteria for developing the public interface is defining who is the public. Museums generally attract a wide and diverse audience of varying ages, backgrounds and interests. Defining the age group, cultural background, reading skills, interests, size, and single/ multiple users will help define who is the intended audience and any specific considerations related to that audience.

A second criteria is determining how long an interaction is desired. Most hands-on mechanical exhibits average less than one minute of involvement. The interactive exhibit can have the potential for short involvement by design or extended involvement (up to 1/2 hr. or more) depending on the scope of the content. Other factors affecting interaction time include:

- single or multiple use
- school group vs. family group
- location on museum floor
- age of user
- comfort / visibility

Given the breadth of the visitors' interests and experiences, a third criteria is deciding what sensory learning modes shall be addressed: reading, hearing, seeing, or moving. Combinations can be weighted to simultaneously address multiple learning modes and to allow the user to select those which prove individually useful.

A fourth criteria is asking how complex is the content? Identification of the scope and complexity of the content will help define the structures for organizing and navigating through the material.

Formative Evaluation

All the above are critical to the definition of a public user interface. Before basic design issues are considered: how screens look, what type of authoring systems are used, hardware specifications, the user issues need to be answered. This entails an on-going involvement with the target audience and forms the basis for formative evaluation in the prototyping process.

A surprising number of projects bypass this issue due to the realities of budget, time schedules, and bruised designer egos. Unfortunately formative evaluation is rarely budgeted for as a necessary phase of design, and therefore is unlikely to take place. Without this critical prototyping phase the museum visitor will have little opportunity to influence the development of exhibits that they will use.

Through this interaction with the target audience, design issues can be explored at a developmental phase which allows for easy redesign or changes in goals or scope. The key factor is the ability to develop content materials (all media - not just printed scripts) to a meaningful level for evaluation without going so far that they can't easily revised.

Navigation / Content Structures

How does this thing work? Probably the most often asked question and the most difficult to address. There are a multitude of approaches to breaking up and presenting content and navigating through it. A basic question forms the philosophy of the design. Is the user in control or is the program? In many computer based training programs testing is an important consideration alongside limited access to sequence of topics. Museums will need to decide if they want random access, linear access, or restricted access. Information can be presented in seven primary modes:

- single screen (all information appears to be in one screen)
- nested topic / subtopic / secondary (hierarchical)
- contextual (virtual reality, object oriented, AI)
- linear (forwards / backwards)
- network / hypertext (any screen / text linked to any other screen)
- animated sequence (no control over sequence)
- rule based

Numerous permutations of the above are possible allowing for using different modes when most appropriate to the content. These modes can also respond to varying interest levels:

- overview (what is in here?)
- browsing (just looking)
- investigation (searching / sorting)
- response (linking)
- review

One of the most vexing areas of interactive design is taking the content structure and mapping this structure to interface designs which complement both the educational and navigational goals. Along with these structures are the development of appropriate metaphors for representing the content including:

- appropriate scale
- comparable depth of information
- realism
- density of information

This design stage benefits from a team approach with creative input from multiple points of view and specialties. A good one-third of the design process is this tug of war between content and navigation structures and metaphors.

Interface Features

Some pivotal interface features appearing in most successful interactive exhibits include:

- the users know where they are in the program at all times
- the users can easily get to the area of interest, while going through the least amount of information to get there
- answers the question "how does it work?"
- consistency of interface metaphors (icons, buttons, navigation structure, sound)
- the appearance that the user is always in control of the process
- content is grouped in a way that the user anticipates the next subject or level
- complex content feels simple
- the navigation structure is appropriate to the nature of the content
- the media used is appropriate to the information density desired
- more than one mode of sensory learning is available
- the navigation process does not interrupt visual or sonic comprehension

Appropriate Media

During the last three years technologies related to interactive computing and their application to exhibit design have exploded. The cost vs. performance ratio has accelerated at a dizzying rate. At first bloom this would seem to represent unending progress, yet we are still in a developmental phase learning how all these new tools work. Nowhere is this more evident than in the use of multiple media, most specifically in random access applications using: text, animation, narration, sound effects, music, video, and still images.

Along with the proliferation of new tools is a more classic dilemma - what is the appropriate medium to convey the message ?. In a world where you can turn narrators on and off, slow the pace, pause phenomena midstream, zoom in or out; the choices can become overwhelming. Each available medium has attributes which lends itself to certain content treatment.

With the ease of pointing a camera and hitting the record button the integration of full-motion video into interactive applications brings up a number of questions:

- does the video used convey the information we desire at the proper scale, lighting, color balance, etc.?
- how do we get video images of phenomena that are too small, too large, moving too fast / slow, have too little light, etc.?

- is the interactivity limited to on-screen buttons running video clips?
- are talking heads useful visual information that help explain the content?
- to what degree should interactive video applications mirror passive TV functions vs. dynamic user interaction?

Repurposing

There is a growing realization that production of original video material for interactive use is so expensive that recycling material made for other purposes will yield a treasure trove of useable content for numerous purposes. There is even a growing industry (witness ABC interactive) which is founded on this concept.

A troubling question arises when one imagines a work such as the Martin Luther King videodisk being planned, and a hypothetical comment is made concerning the lack of pivotal footage because another network covered that event. Would the content be changed, or would ABC acquire the rights to the needed materials?. Is content development compromised by ready access to material which may be close to, but not exactly what is needed?

When it is not possible, desirable, or affordable to use full motion video an alternative is the use of animation or simulation.

Animation

When does animation become the obvious candidate? Animation or simulation offers potential solutions when the literal is no longer desirable or practical. Use of animation sequences offer a number of possibilities:

- conceptual abstractions
- varying degrees of detail
- variable tempos
- higher degrees of user interaction
- simplification of content for greater focus
- combinations of varying scales
- unique points of view
- breaking long sequences into smaller digestible pieces

Particularly in science areas it is common to need stunning imagery that is unattainable in the format needed (i.e. having a static electron microscope image, but needing full motion), or unavailability of particular images.

A critical issue of scale is often overlooked. Sometimes an image is just not available at the appropriate scale. The first response is usually "well, just blow it up larger". This ignores the fact that you need more information, not a bigger image on the page. Some current fractal models demonstrate the ability to zoom in ever closer and still get more and more detail, but presently this is limited to mathematically based images. A classic paradox exists in the comparison of two seemingly identical photographs, but upon close inspection one caption reads "a closeup of a river bed in Arizona," the other "a rock flow on Mars."

A difficulty in presenting users with interactive environments is they often feel the detail and levels of information should be endless without any consideration for the complexity or expense to create such depth.

Simulation

How does simulation differ from animation? Animation is typically approached from a sequential cell animation concept (ala Disney) which allows the visitor to initiate a series of movie-like sequences, whereas simulation necessitates a higher level of interactivity. The user actually takes a role in the phenomena vs. simply initiating or stopping it. Simulation involves the modeling of the phenomena and the potential for greater interactivity and multiple points of view. It also demands a new level of software - object oriented programming which will allow separate objects to respond to other objects in a multitude of ways. Not only must the programmer view the project as a simulated experience, but new demands are put on other members of the design team to conceive of their parts as a contribution to a fluid whole.

Multi-disciplinary Design Teams

A museum wanting to create interactive exhibits in-house needs to consider the flexibility of their staff. Creating an in-house design and production team means the project manager must be familiar with the issues of:

- software design specifications and performance
- hardware specifications and performance
- interface design
- content hierarchies
- use of appropriate mediums (sound, animation, video, graphics, text, narration)
- contractual / copyright liabilities
- maintenance issues
- evaluation
- kiosk design

The standard issues of project management - staffing, scheduling, and fiscal responsibilities also play an integral part. Scheduling of interactive projects is a subject beyond the scope of this paper, but critical to the success of the project.

A design team can consist of between one to twenty or more, but because of budget and production considerations the smaller the better. This team is often made up of: content specialists, writers, graphic designers, software designers/programmers, sound/music designers, animators, video/audio/computer technicians, and other consultants and advisors.

The balance of talents and tasks varies greatly depending upon the individuals available and the budgets available. Since making an interactive exhibit demands integration it is extremely important that each team member recognizes the value and contributions of the others. These projects often fail based upon their weakest link - cooperation.

Too many specialists can be a recipe for disaster. Each will try to lobby for their specialty and its ability to carry the project. A project manager who is able to oversee and balance the functions and abilities, and gingerly massage the process down the road on time and on budget is a rare breed as well.

Designing interactive exhibits is not a science, it is constantly in flux and responds to changes in software, hardware, and interface design, and the demands of more experienced users. The best design group is motivated to respond to the visitor, change directions when necessary, and is excited by what is around the next technological bend and how this will help communicate the subject matter.

Controlling the Interface

Once we get all these elaborate elements in place, how does the user control the exhibit? The evolution of controlling computers has had curious twists. Early on came the keyboard which mimicked the typewriter, for computers at that time were large calculators. Xerox P.A.R.C. then introduced the mouse along with the concept of the computer as a visual medium. Almost 25 years later we still primarily use the mouse and keyboard. Central to the issue of controllers is the information they control. Using keyboard keys to control audio functions simply is not appropriate. How do we access time based media such as video or animations? When we move away from the computer as solely a visual instrument with a screen, new possibilities arise for exhibit designs.

The most common controller at present is the touchscreen, which has drawbacks including: relatively high cost, dirty screens, parallax problems, viewing the hand in front of the content, and limitation of finger size and capacitance. The touchscreen is again going back to the typewriter - still holding on to the use of metaphorical buttons as access to multi-sensory information.

A breed of new controllers have emerged some modifying the basic mouse, and others pointing to new directions including:

- lightpen and pen based tablets
- trackballs, joysticks, control wheels
- ultrasonic devices worn on the head (turning to greet a visitor could have disastrous consequences)
- eye trackers (tracks the position of the eye's pupil and translates the data into screen coordinates)
- data gloves (responds to position of hand in space and articulation of the fingers - Nintendo Power Glove and VPL DataGlove)

- position sensors (locate the position of a hand / or head in a defined space - Broderbund's Uforce and MacDonald Douglas' Polhemus sensor)
- 3D / 6D controllers (University of New Brunswick Bat, Spatial Systems Spaceball, Sim Graphics Engineering Flying Mouse, Sensor Frame Corp. Sensor Cube)
- natural speech commands (coming, coming and still coming)

A number of kinesthetic issues arise, largely due to the inability to represent force feedback (with a DataGlove you can hurl yourself through a wall at great velocity when you relax the wrong finger by mistake). Picking up a simulated chair with no weight misses essential feedback about gravity. Very little work has been done in the area of smart knobs - ones that respond appropriately to the task (i.e. turning gets harder as the load meets resistance).

Sonic directions

Until the last few years the digital computer was not a stunning performer when it came to the sound domain - graphics was dominant. Even though Apple Computer built sound functions into the Macintosh, it took almost five years before the use of sound with computers reached and surpassed the analog audio potential.

Current hardware and software combine to allow flexible recording, mixing, editing, signal processing, sound synthesis. CD quality is now easily achievable with moderate expense, and in the next two years will be cheap. Compression of sound files is underway and synchronization of sound files to animation and video will allow sound to be imbedded in new "compound" documents and presentations.

One missing element is the use of binaural sound. Binaural recording has been around since the mid 1940's and uses microphones placed at the ears. The sound is recorded as the ear would hear it, and when played back over headphones has stunning localization. All of a sudden we live in the middle of a sound environment as we normally do. Sounds move overhead, from behind, skim along the ground and, in contrast to an artificial left/right stereo, they become dynamic in space. With the proliferation of headphone use today this is an area which is ripe for development. The Ames Research Center at NASA is presently the leader in developing a synthetic binaural experience - making it possible to place any sound anywhere in a sonic architecture.

At present, few of these audio capabilities are built into interactive exhibit development largely because of a long time bias towards text and video. Sound localization cues can greatly enhance our understanding of certain phenomena. For instance, we now have simulated architectural walkthroughs. Imagine as you walk through the space the sound of your footsteps and voice changing as does the architectural view. Consistent use of sound cues can reinforce interface metaphors and navigation, and help users who are more receptive to auditory sensory modes of learning.

Future Developments

On the surface these are fascinating developments and truly hold promise for more than an enhanced shoot-em-up video game; but a great deal of effort must be put into the human factors, the potential for ease of use, flexibility of control, and application to appropriate content. Many of these devices are just now allowing us to break new boundaries in controlling a new world of simulated realities.

A project is underway at the New York Hall of Science in Queens, N.Y. to create a series of new interactive exhibits on audio technologies. A few potential applications of new controllers and their consequences to a public interface may be:

- an original Edison wax cylinder being played by laser (allowing the public endless use of the cylinder with no wear, and random access to any point on the cylinder along with the ability to transform pitch, repetition, and rhythm by moving the laser along the cylinder)

- a walk-on sound mixer with 16 tracks of music controlled by two video cameras and software which could recognize the visitor stepping on one of the simulated tracks and activate that particular track of the multitrack recording (movement recognition would be in software allowing the system to respond differently to one or thirty - solving a common problem with interactive exhibits)

- a set of binaural headsets - headphones with microphones attached, are placed at two towers a distance apart allowing two visitors to trade ears with each other (each hears the head movement and sonic perspective of the other)

- an aural history of audio devices (the visitor steps up to a range of audio devices through history and speaks into a microphone.- they hear their voice come back through that device along with the attendant noise, distortion, and filtering - presenting the evolution of audio technologies as a sonic phenomena vs. text or visual)

- a set of manipulated "sound" blocks (blocks which can be arranged and manipulated on a tabletop to mix each sound associated with a block when the blocks are stacked one atop another, or play the sounds in sequence if the blocks are arranged in series or a mixture of both).

It is clear that the future directions of interactive interfaces and exhibits will use more extensive input from the user including physical gestures, voice, eye movements; and the exhibits will respond in multi-sensory modes with the ability to place the user in articulate control of the experience. This is a large challenge to the button-pushing interaction of today, but with attention and patience to detail it will radically transform the field of exhibit design.

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