SEVEN WOODS AUDIO, Inc.

Concepts, Products, and Circuits for Audio • Analog / Digital

Product Usability

Application Note AN-7 **by Christopher Moore**

Introduction

Most of us in product development agree that usability is important, yet we still encounter many products in our daily lives that cause us to curse the unseen designer, crying, "The person who designed this @!#*&! thing should be forced to use it!"

I will present some of the concepts of usability and try to persuade you how important it is. As examples, I will use audio products with a predominantly hardware user interface, including the Orban DSE-7000.

Background

Usability is only one dimension of new product development, and unfortunately it is often given short shrift. Professionals skilled in product usability are generally found in larger companies, so that usability design often falls to engineering and marketing. Unaware of usability engineering's underlying principles and lacking the perspective that a day-to-day working practice in usability would give, designers frequently create products that are difficult to learn and awkward to use. This leads to dissatisfied customers with negative attitudes toward the manufacturer, operational errors, and a surface level use of the product that leaves hidden features forever unused. In some industries, poor usability leads to dangerous products that injure people. The usability literature contains sobering examples of aircraft crashes, nuclear power plant accidents, and tragic medical errors that were traced to poor usability design.

On a more positive note, companies are striving to create competitive new products, products that offer advantages in performance and features. What could be more competitive than products that delight the user by their ease of learning and use? Give your customers equipment which reveals its operation via its user interface, and they will be an enthusiastic virtual sales force.

Orban DSE-7000 Digital Sound Editor—A Good Example

In 1987, while I was the Executive Vice President of AKG's Digital Product Division, I conceived a digital audio workstation for radio stations and began directing a small development team to design it. As I write this, in 1997, the DSE-7000 is not only in the marketplace still, but is the leading product in its class, widely loved by its users, as this testimonial from John Chickering attests: "The other distinct advantage of the DSE is the well thought-out hardware interface. I had been working with analog production for years, and I discovered that I was doing more and better work on the DSE in a couple of hours. The large work surface and sturdy controls were a refreshing change from Tinkertoy systems where you squint at a screen while pushing virtual faders with a mouse. No thanks."

Here are some of the things that we did to make the DSE-7000 so easy to use:

- observed and interviewed users at their workplace
- created the owner's manual, rich in detailed presentation of user operations, before beginning design
- based the user interface on actual user tasks
- accepted a lead user on to the design team at an early point
- iterated the design in light of early user experiences

Selected topics from usability engineering

Given the space constraints of this application note, I will present only a few ideas from usability engineering—enough to give you a feeling for the field and hopefully to raise your level of interest.

Affordance When a control device's appearance reveals how it is to be used, it is said to be an affordance. A button with a concave surface invites pressing, while a cylindrical knob suggests grasping and rotation.

Mappings The manner in which control layout and action match those of the controlled elements is called a mapping. The classic example is the control layout for the burners of a stove. In my experience, stove controls rarely map well, often requiring a second attempt to get the correct burner lit.

Control sense Users expect an increase in the controlled parameter (e.g., volume) when they move a slider upward, push a slider away, or rotate a control knob clockwise.

Consistency When multiple occurrences of similar interface features are handled uniformly, the interface exhibits consistency. For example, a music system with separate button pairs for CD track selection, tape search, and FM tuning should have the right hand buttons all increase or advance the media. Consistency is generally highly desirable, although there are exceptions. See Grudin for an interesting presentation of consistency in its three domains: internal to a product, among similar products, and between a product and an analogous, perhaps earlier, product.

Mental model A product should encourage the development of a mental model of its operation. In the DSE-7000, a computer based audio storage and editing system, the dedicated user work surface enforced the model of a multi-track tape recorder and a mixing console. The graphic display further emphasized the model with both a local, detailed track display that scrolled

slowly from right to left, and a global display of the total duration of the "tape."

Errors Good design will result in a product that is so clear that there will be few errors. Those errors that do occur should be handled by the product with grace, forgiveness, and a way of backing out. Certain Hewlett Packard calculators have several features that reduce the pain of errors. If you enter a digit of a long number incorrectly, you can backspace and correct it. If you press a function key and suddenly get the sinking feeling that you wanted COS, not SIN, you simply hold the key for a second or so until the display shows the function name, then release the key, aborting the operation. In good design, you should anticipate all the errors that you can and provide means to recover from them. Surely the days of "Abort, Fail, Retry?" and "General Protection Fault" should be numbered....

Minimalism Minimalism emphasizes the benefit of simpler products, fewer features, and more concise documentation. In the competitive world of audio and video products, not to mention software, manufacturers vie to provide the most features. Software manufacturers are driven by a desire to populate their row of the large product/feature matrices seen in magazine reviews with a solid string of check marks. But sometimes less is truly more. Does the CD player in a boom box really need to allow the creation of a sequence of track playback? Try giving the user less to wade through, less overhead, less to read and she will achieve more.

Iterative design When designers test their product with real users and modify it several times until hesitations and errors are at a comfortably low level, they are practicing iterative design.

Visibility Controls ideally should remain visible and available at all times, reminding the user of their existence and facilitating the formation of a mental model of the product. When a product's interface can be in more than one mode, control visibility comes and goes and errors occur easily. If there must be multiple modes, then a clear display mechanism to indicate the current mode should be provided.

Transparency The nirvana of a user interface is that it vanishes and the operator simply uses the product to accomplish his tasks. A well designed automobile may present the driver with nearly 100 controls, but he rarely has to think about "the user interface."

The total environment Good product design is impossible unless engineers put themselves in the shoes of their users by visiting them where they work. One must learn how the product is learned and used, where its input comes from, where its output goes, and what other equipment is in the work environment. When we were developing the DSE-7000, we observed radio production engineers preparing broadcast spots. I saw several striking and unexpected things. One was that these people were under so much time pressure that they worked quickly and instinctively, despite using what we regarded as older and cruder tools. Another was the energetic ways that they moved while working: rolling around from one machine to another on chairs with castors, jabbing buttons, grasping tape reels, and manipulating multiple faders. These visits led us to abandon a mouse and graphic screen as the primary interface; we took what had been an optional dedicated work surface and made it a mandatory part of the system. I just couldn't imagine confining these production engineers behind a mouse, keyboard, and graphics display (yet this is just what most competitive systems had done at that time).

Task oriented design It's good practice to explicitly state the tasks that users expect to perform with the equipment you are designing, then order them according to importance and frequency of use. The user interface should support the execution of these tasks, reflecting their relative importance.

Stages of user interface evolution It has been observed (Grudin and Gentner) that as new products evolve, they are at first modeled according to their underlying technology. Gradually, they begin to become more oriented to user tasks. A particularly intriguing area of user interface design is deciding how much the interface should be based on user models of earlier tools, as opposed to new and better models. This came up several times in the design of the DSE-7000 and in most cases we opted for mimicking earlier tools. For example, we considered using what I called the "audio snippet" method for locating a particular instant in a recording by ear (the way your CD player cues and reviews within a track). But because we knew that all our users were accustomed to "rocking" the tape reels and locating the cue point by "scrubbing" (listening to growling audio), we replicated this instead. It was probably the right choice, although it is arguable that faster and more accurate results might have been obtained with the use of audio snippets. And, as the years go by, fewer and fewer engineers will remember open reel recorders, while they all will be familiar with snippet cue/review from their CD players. One has to chart a thoughtful course between the old and the new. It is certainly the case that the possibilities opened up by new technology eventually must force user interfaces to break free of old models.

Testing methods Formal usability testing involves carefully structured experiments involving real users asked to carry out certain tasks under controlled lab conditions. Often the users are video taped through a one way mirror for later use in focusing on particular usage problems. A good program of formal testing will result in a superior product.

Heuristic usability effort Even if you can't afford a full blown usability project, a scaled down treatment is still far better than none at all. Nielsen and Molich advance a convincing argument for at least having a few usability professionals audit a new product, testing it against a short list of usability heuristics. Such testing can uncover a significant percentage of the more glaring usability problems.

It's not the user, stupid Many people assume that its their fault when they are flummoxed by a piece of equipment or software. They feel stupid, clumsy, and out of date. While the inexorable forward motion of technology with its ever-expanding possibilities does indeed challenge the user to learn new skills and master new devices, a major portion of user interface difficulties stem from bad design.

Two perspectives on usability from literature

I think often of these lines from Yeats' *Adam's Curse* describing the creation of poetry:

> "...I said: 'A line will take us hours maybe;
> Yet if it does not seem a moment's thought,
> Our stitching and unstitching has been naught."

The reward for hours of usability optimization should be a product whose user interface vanishes. The product is effortless to use...usability nirvana.

I'll close with an excerpt from "Wind, Sand, and Stars," by the French pilot/author Antoine de Saint Exupéry. Writing in 1939 of his experiences as a mail pilot in France, Africa, and South America, he describes the fit between himself and his plane's "user interface" in language that is pure poetry:

> "Meanwhile, startling as it is that all visible evidence of invention should have been refined out of this instrument and that there should be delivered to us an object as natural as a pebble polished by the waves, it is equally wonderful that he who uses this instrument should be able to forget that it is a machine.
>
> There was a time when a flyer sat at the centre of a complicated works. Flight set us factory problems. The indicators oscillating on the instrument panel warned us of a thousand dangers. But in the machine of today we forget that motors are whirring: the motor, finally, has come to fulfill its function, which is to whirr as a heart beats—and we give no thought to the beating of our own heart. Thus, precisely because it is perfect the machine dissembles its own existence instead of forcing itself upon our notice."

Notes

Orban and DSE-7000 are probably trademarks or trade names of Harmon International or its subsidiaries.

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Mission statement of Seven Woods Audio

I am an electrical engineering consultant specializing in the conception and design of products and circuits used in audio applications. My company, Seven Woods Audio, is committed to helping manufacturers quickly create digital or analog audio products that generate a good return on investment, work right the first time, sound excellent, and please the end user. Seven Woods Audio works with manufacturers of professional audio, consumer audio, broadcast, telecommunications, and computer equipment.

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