Designing and Evaluating the User Interface

Make your Design User Seductive

The average consumer has no difficulty driving an automobile or getting cash from an ATM, yet is stumped by a VCR, security alarm, and office phone system!

Why?

Frequently, it's the user interface.

Before looking at how to minimize such dilemmas in product design and selection, I review the user interfaces available on the market today and how to determine which are appropriate and for what kinds of applications.

DESIGNING FOR HOME

In the past few years, we've seen many new products, services and concepts bring the power of computers and information technology to the average home. Although we accept this as good and inevitable, as masters of technology, we tend to be comfortable with computer interfaces and the learning curves required to use them.

For the average homeowner, however, such devices are threatening. Offered a choice between learning an unfamiliar technology or bypassing it (e.g., going to the wall to flip the light switch), most homeowners inevitably choose the familiar.

It's slightly different in the business world. There, computers have gained a foothold mainly by force. Anyone entering the workforce in a clerical or office-support environment has no choice. They must learn standard software.

Only upper management has been able to resist computers. However, as they find themselves shut out from the information around them, even they are taking the big step.

At home. though, most people can choose to accept or reject technology. When X-10 devices first appeared, I installed them at home. I was thrilled, but my roommate threatened to throw them and me out if she couldn't turn on the lights the "normal" way!

We accelerate acceptance of new methods by forcing people to use them. If you could convince people to buy homes without conventional switches, they would soon use the new devices. In fact, it seems to me that home automation gains a foothold just this way: sell its benefits to the home builder.

Eventually, the products that are successful seduce potential owners with easy accessibility and a promise of rewards. The development of user-seductive human-to-machine interfaces is undoubtedly the most critical milestone in creating a viable market for home systems.

WHAT IS A USER INTERFACE?

Although initially defined by Webster as a common boundary between two bodies, spaces, or phases, its secondary definition fits our purposes better. In this context, it's the means by which interaction or communication is achieved.

Most electronic systems have at least two interfaces: the thing producing functional results (e.g., a relay, printer, light, or display) and the method or organization defining functions to the operator or user.

The value of an interface depends more on the user's ability to comprehend its function, than on its actual capabilities.

WHAT DO WE EXPECT?

To be useful, the user must be able to perceive a device's function. The phrase "Form follows function" is particularly appropriate with a computer interface.

User interfaces generally fall into three types: intuitive, specific, and directed.

With an intuitive interface, the user needs no specific instructions to perceive its function or use it.

ORRIN CHARM

Although average consumers can handle automobiles and **ATMs,** they're stumped by VCRs, security alarms, or office phones. Orrin traces these difficulties to the user interface. He shows how to minimize such dilemmas for interfaces like remotes, video monitors, telephones, control panels, and voice-control products.

Generally, a push button is an intuitive interface. Think about elevators. It's usually obvious what is accomplished by pressing the button. Similarly, a doorknob or drawer pull is intuitive.

With a specific interface, function is easily understood with minimum information. If the push button is labeled "Exit" and is near a door, its application is easily understood by any user who understands the word "exit." Specific interfaces involve more of the user's time and concentration.

The directed interface gives specific instructions on how to operate the device. If a button reads, "To open door, press red button and hold for three seconds, then release," it would be considered a directed interface. A casual user who didn't read the instructions would probably push the button, try to open the door, and conclude the system was defective.

There are two principles to bear in mind. First, a device that requires no instructions is easier and faster to operate. Second, a device that requires instructions should be clearly labeled to avoid confusion.

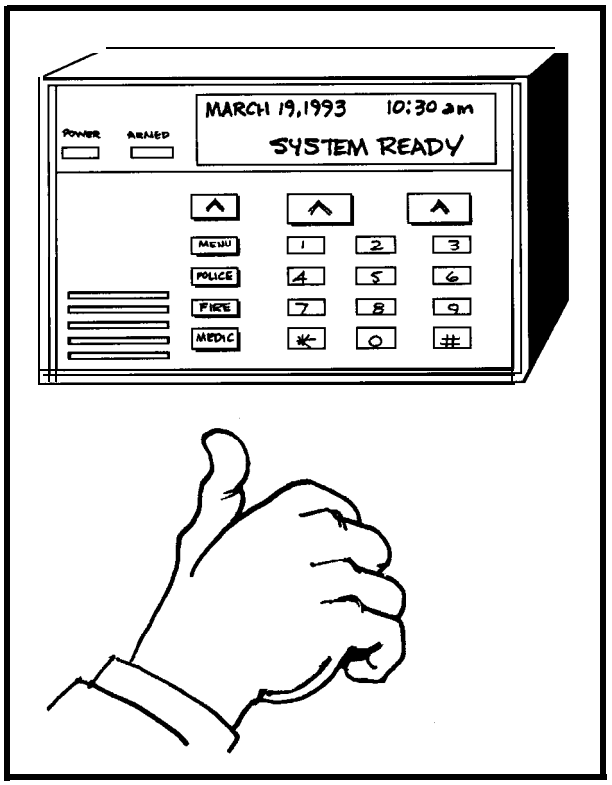

Figure *1: This alarm panel is accessible, but obtuse. What is the user supposed to do?*

USER FRIENDLY OR SEDUCTIVE

A user-friendly system is one that does not seriously challenge or obstruct the user-at least not as much as its predecessor did. The term implies that the user is able to use the device if the user chooses.

The user, however, frequently has a choice. If there is a simpler or more accessible means, the casual user chooses that one instead.

However, we want users to choose our products. A user-seductive interface is one that is not only usable, but desirable. It *leads* the user to perform the proper actions.

What makes a user interface seductive?

- Visibility-If a control is hard to find, see, or read, users are put off instantly. While this appears obvious, it is startling to see the number of products with LCD displays that cannot be read under normal (bad) lighting, can't be found at night, and have buttons that can't be read or are hidden behind doors.
- Clarity-Any user interface should clearly display what it is, what it does, and what its user options are. The user should not need a manual.

  Security controls are the worst offenders—do providers believe an inscrutable front panel is the first defense against intruders? If the user needs to enter a passcode, the device should read "Enter Passcode." On a complex display, buttons available for user input should be highlighted.
- Predictability-The device must respond the same way every time. Although multifunctional buttons conserve space and reduce cost, they are extremely confusing. Buttons should also respond the first time they are pressed.
- Feedback-The device should confirm that input has been received. Since accurate and immediate feedback is necessary, if confirmation takes longer than 100 ms, the device needs to provide a local indication to prevent the user from repeating the function, especially if the function is a toggle!
- Recoverability-The user device should be able to recover from errors gracefully, with specific prompts on how to proceed.

  Trapping users so they cannot return to the beginning, cannot undo an error, or must guess at options causes them to become hostile to the device.

  If the menu structure is multilevel, specific keys should return the user to the top level immediately or up one level per press. If the user jumps to the top level, it may be useful to provide a way to return to the previous place.
- Masterability-While menu-driven pages and extensive help are invaluable to a novice, they quickly become an obstacle for a power user. As a user gains proficiency, the system should provide shortcuts and macro functions to speed user input and provide a sense of mastery. Multiple paths let users find their individual comfort level.
- Customization-Function labels should correspond to their actual operation. The user interface should provide the ability to label buttons for each application. Ideally, the buttons should be easily relabeled aesthetically in the field.
- Serviceability-Service should be possible without inconvenience to the user or damage to the device or its mounting surface. Wall panels should be removable without damaging paint or wallpaper. If possible, routine maintenance should occur without removing the device or even remotely.
- Cosmetics-Most user input devices are installed in a variety of environments. The device should blend with most decor, have a variety of finishes, or be treatable to match existing finish. To cut cost and inventory, the visible portion of the device might be low-cost and separate. Then, custom finishing can be done before final installation.
- Comfort-The device should be usable for an extended period without causing the user discomfort. Size, weight, visibility, key pressure, feel, and location should be considered. The location for the device must be consistent with the nature of the interface.

Figure 2 illustrates many of these good characteristics.

INTERFACE TESTING

A good friend uses a "toaster test" to qualify a new technical product.

A toaster has the ideal interface. It has two slots about the same size and shape as bread and a single lever that moves in the direction you want the bread to go. There's no other user intervention, other than occasionally moving a small knob that's labeled "Light-Dark" or colored the different shades of toast.

While there is a manual-just to let you know not to wash the toaster while it's plugged in-it is superfluous. All you need to know is obvious.

All products should be this easy!

Many products in our lives are considerably more complex. Yet since we deal with them all the time, their operation is intuitive. A television is complex, but people know what they need and ignore other functions.

An automobile is an extremely difficult device. However, learning to drive is a common experience. Most people drive in a very short time. Once learned, it's as easy as a toaster.

An automatic teller machine is a more recent example of a learned interface. With the exception of a slot for cash, an ATM is not much different than a computer! The slot offers enough incentive that most people learn the operation quickly.

Moral: If your product dispenses cash, people will learn to use it.

While most folks easily operate their TV set, their VCR poses a more formidable challenge. The additional choices force the user to adapt to the machine's needs, rather than having the VCR respond to the user's desire.

Devices like VCR+ and on-screen TV guides greatly simplify the situation. Users can then say "Tape Married with Children" rather than "Record cable box channel 11 on next Wednesday at 9:00 P.M. for one hour at low speed." This sort of logic is alien even to some high-level COBOL programmers I know!

Also, the VCR gives no indication that it's been programmed correctly; you don't know until the show is over. This negative reinforcement causes many to be frustrated and give up.

A computer also is a masterable interface. With the proper software, it gives instant and positive reinforcement, so the user learns by practice. The software designer is responsible for keeping users out of trouble.

A security alarm system should be easily mastered. Its functions are limited, and there are few choices to make. Yet, many alarm controls are a source of frustration to their users. Many alarm manufacturers conceal the structure of the systems to confuse the miscreants. They only confuse the proper users, who daily use the system.

MASTERING THE INTERFACE

Because of our intelligence, humans take pleasure in mastering their universe. The pursuit of skill is a powerful motivator. The success of video games proves that people can be driven by no greater reward than the ability to become more adept at simple tasks.

The video game model can be applied to other interfaces as well. If your interface needs to be complex, challenging the user to learn its nuances is rewarding and results in greater comfort and familiarity.

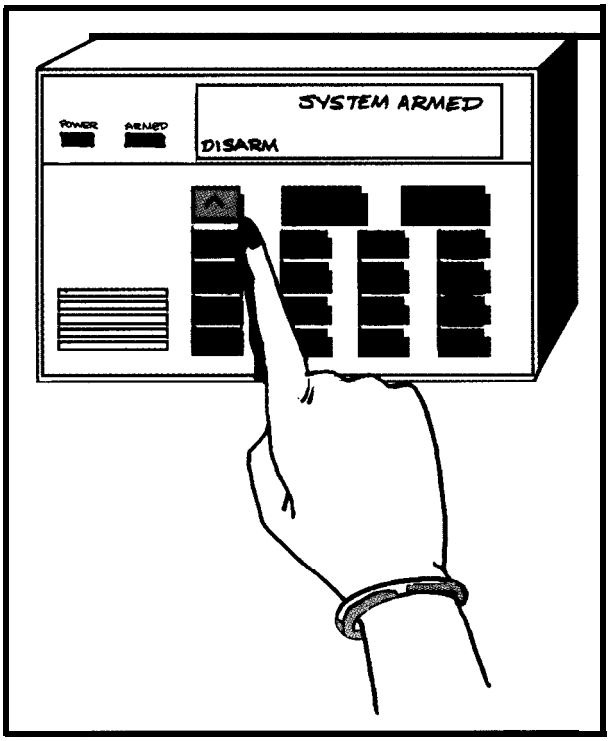

Figure 2: *This panel, similar co the first, has a crucial difference: the user is told exactly what to do. Presumably, after pressing "disarm," the user will be told to "enter passcode."*

Using rewards rather than error beeps to keep the user on-track is one method. Showing complex functions in a staggered manner after the user has mastered simple ones may be less confusing than presenting all functions at once. Group advanced operations separately from basic ones.

Functions may be accomplished by several methods. For novice users, a hierarchical menu structure with on-screen help avoids confusion. Shortcuts or macro keys aid the advanced user.

Let the expert customize the interface. Common functions should condense into a single keystroke. Rarely or never-used functions should hide or be removable.

It's useful to store both the customized and default function sets so either can be recalled. If the user can be identified by a passcode, the system could automatically load that user's preferences.

USER INTERFACE DEVICES

Switches are most suitable for obvious locations and basic functions. Access is fast and limited. Switches are generally mounted 3648" above the floor. Their function needs to be clear at a glance.

Keypads suit fixed locations and simple functions. Keypads without displays are generally 42–60″ above the floor, so functions should be clear and consistent. Keypads with displays should be placed at **eye** level (54–60″ above the floor).

Soft keypads, where the button function labels vary and are defined by the display, have more versatility and can be easily customized. As button functions vary with menus, visibility is critical. Because key locations are fixed, experienced users often press buttons faster than the display can respond. The system should buffer input to prevent the user from getting lost.

Touchscreens are extremely versatile and adapt to many input and display options. Because there's no tactile feedback, input tends to be slower than with fixed keys. Functions are frequently defined by menus, so locations may change as pages flip.

Touchscreens lend themselves more to menu-hierarchy functions than to data input. Users can offer rapid input more easily if expected sequences occupy the same physical coordinates.

Wireless remotes offer the convenience of freedom of movement. Most wireless remotes are one-way, so the user must rely on external feedback for proper operation. Power consumption must also be weighed against visibility, range, weight, cost, and operational life.

RF remotes offer nondirectionality, longer range, through-wall operation, and generally faster response. Backlighting should be strongly considered. For some systems, a docking station with battery charger may offer more reliable operation.

Using a TV set as a display device offers much of the flexibility of a touchscreen at a much lower cost. However, the TV has to be turned on to operate the system. While this limitation is not a problem for home theater or video-only systems, it may be inconvenient or intrusive for other systems.

Unless high-bandwidth displays can be guaranteed, display resolution also severely limits the usefulness of TV displays. Although interactive video lets a less expensive remote be used, parallax must be considered as the remote and display are not in the same field of vision. Devices like the "Air Mouse" may offer a solution if the eye-hand coordination issues can be resolved.

Telephones can be used as control devices. They are generally already in convenient locations, are familiar, and offer a variety of feedback options. However, the keyboard of a standard telephone set is too limited for a wide range of functions, and feedback generally requires the user to hold the receiver near the ear while waiting for a voice response.

Most people are only moderately familiar with the additional functions of an electronic key telephone set, and the displays of most sets cannot be accessed by control system designers. Furthermore, the location of telephones may not correspond to the desired location of input devices.

Voice recognition and response has been considered an ideal interface, as it requires little or no hardware or physical interaction by the user. However, it has many practical as well as theoretical limitations.

While faster processors, DSP devices, and cheaper memory have improved recognition systems, existing systems have severe limitations. User independence, continuous speech, context-sensitive processing, and inferred logic are difficult to achieve reasonably.

Psychologically, users aren't comfortable speaking to a system with low recognition rate and that appears to not have significant intelligence. Headsets make many people feel like they're talking to a wall.

AESTHETICS

For residential applications especially, aesthetics are fundamental to user acceptance. No matter how functional a device may be, if it offends the owner's taste or clashes with the decor, its applications may be compromised. It may be placed in an unobtrusive location, where its potential may go unexplored.

An integrated user interface replaces myriad single-purpose devices. This multifunctionality alleviates the "wall acne" caused by a wall surface being littered with a variety of aesthetically clashing and inconsistent devices. A common user interface generally appears more attractive and easier to use.

When integrating a number of systems, avoid ergonomic conflicts. Electric light switches are 36" above the floor, a convenient hand height. If the device contains a display, it's impossible to read at that height. Place the display at eye level—preferably the owner's eye level.

Placing the light switches at that height disturbs users who expect to find a switch just inside the door. You may need two interfaces or a keypad the user can find conveniently *before* entering the (dark?) room.

INTERIOR DECORATOR—FRIEND OR FOE?

Most individuals involved professionally with elegant homes have run into the interior decorator whose sense of style ended in the eighteenth century before electricity or even mechanics! They won't accept anything that isn't gilt, ornate, or draped in fabric, and they always want to place a huge painting wherever your keypads need to go.

Since most of their other clients apparently have servants, the notion of someone actually touching something in their rooms is abhorrent. They hide telephones in drawers, banish television sets, lock up remote controls, and generally make life difficult.

Usually, a compromise can be achieved. Get involved early and include their wishes in your design. They're frequently threatened by technology. Alleviating their fears may make them allies, not competitors. Just remember-your best referrals are from interior designers.

CONCLUSIONS

Much of this material may seem familiar and obvious-and it should be.

Surprisingly, though, most of the systems and devices we encounter in our daily lives intrinsically violate many of the principles discussed here. Measure and evaluate the effectiveness of your design against these human criteria.

Test your design with untrained users. If they can understand and effectively operate the device, it falls in the "obvious" category and will be easily accepted. If they are confused and frightened, redesign.

If they refuse to give it back, your design is truly user seductive!

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I R S

419 Very Useful
420 Moderately Useful
421 Not Useful