Appendix III — Accessibility of Power Controls[1]

Careful attention to accessibility was part of our original project plan, and also something that the Professional Advisory Committee repeatedly made clear that it was also a priority for them (the general topic, not just for power controls specifically). Too often in design processes, accessibility is considered long after the main design has occurred. We wanted to consider it concurrently, to provide feedback to the rest of the standard.

The premise of accessibility is that it is possible and desirable to facilitate the widest range of people to be able to readily engage in a given activity — to remove barriers to access that may arise from any number of disabilities. From the perspective of the Power Control User Interface Standard, greater accessibility of power controls facilitates more energy savings and greater consistency in user interfaces, and so is only a benefit. As the user interface standard is not mandatory, inclusion of accessibility provisions in the standard does not burden any product or manufacturer. So, as long as there are sound provisions available to make power controls more accessible in a standard way, they should be included.

Many discussions of accessibility note that measures taken for the purpose of accessibility often also have benefits for the majority population. One example is audio feedback during a state transition; this can be essential for the blind or those with limited sight, but can be useful for anyone when the device in question is out of view, or not being looked at directly. With the increasing portion of the population that is elderly, diminished faculties are an ever-growing reality.

Accessibility of power controls runs into challenging problems. For example, how should a device that is *off* indicate that state to someone who is blind, when audio feedback is the usual way to make devices more accessible to the blind?

1.0 Background

The most commonly addressed disabilities are inability or difficulty in: seeing, hearing, speaking, touching, manipulating, understanding, or combinations thereof. Similarly, Microsoft divides accessibility responses into the following areas: Hearing, Vision, Mobility, Language and Learning, Seizure Disorder, and "All"[2]. The greatest problem of accessibility of power controls is for the blind.

The U.S. federal government's efforts around accessibility were most recently (1998) spawned by Section 508 of the Rehabilitation Act. Section 508 standards are coordinated by "The Access Board" (officially the "Architectural And Transportation Barriers Compliance Board") which has an "Electronic and Information Technology Access Advisory Committee" (EITAAC). That committee made recommendations in May, 1999 which specified general areas of IT equipment operation that need to be accessible. The committee recommendations were the basis of a "notice of proposed rulemaking" of March 31, 2000 on "Electronic and Information Technology Accessibility Standards". The final rule was published in the Federal Register on December 21,

[1] This appendix provides detailed background information about the development of the Power Control User Interface Standard. For the full report and more about the Standard, see http://eetd.LBL.gov/Controls

[2] http://www.microsoft.com/enable/products/chartwindows.htm.

2000 (36 CFR Part 1194, [Docket No. 2000-01], RIN 3014-AA25). No changes were made which particularly affected power controls, other than that "Products located in spaces frequented only by service personnel for maintenance, repair, or occasional monitoring of equipment" were exempted (1194.3 (f)). Specific requirements of this rule are addressed below.

Many organizations (standards and other) have policies on accessibility, but the vast majority of these make no specific mention of power controls. There are many general principles for accessible design; the Access Board specifications cover most of these as they affect power controls.

A standard is presently being developed on protocols for assistive devices by committee V2 on Information Technology Access Interfaces of INCITS (the InterNational Committee for Information Technology Standards (operating under the auspices of ITIC).

2.0 Approach

This project has not attempted to invent novel ways to design user interfaces generally, and accessibility is no exception. There are two types of results we sought:

- Insights from the accessibility literature generally that can be applied to power controls in a specific way (we are not attempting to simply repeat general advice), and
- Recommendations beyond that directly suggested by the literature.

We looked to two sources for inspiration: the accessibility community — which we accessed through is literature and members (government, academic, advocacy, and corporate) — and features included on current products.

We contacted *many* individuals that work in the area of accessibility to ask about what the user interface standard should include. Few had ever considered the question and specific recommendations were even scarcer. The one area where we were able to dig deeply into an accessibility issue is making power indicator lights accessible to the "color-deficient"; that is covered in Appendix IV.

3.0 Access Board Provisions

The Section 508 rules defines "Operable Controls" as specifically including on / off switches and buttons. No requirements are made of power controls specifically, but the following general specifications have some relevance to them.

"Color coding shall not be used as the only means of identifying a visual element". An example given is to avoid a web page that says something like "click the red square for more information", and simply adding text to the square makes it accessible. How this can be reconciled with power indicator lights is not clear, but the attention to color specifications should address much of the concern.

Flashing elements are not to have a frequency greater than 2 Hz to avoid triggering epileptic seizures in people sensitive to such phenomena. The flashing rates specified by IEC 73 include "normal flashing" as being permitted to be between 1.4 and 2.8 Hz. The Trace Center, in comments on the proposed Access Board rule, recommended 3 Hz as a better cutoff than 2 Hz.

When actions must be done within a certain time, that time be adjustable to five times the default. This is not intended to apply to long time periods such as typical delay times for devices to go to sleep, but rather to times on the order of a few seconds or less. The only part of power controls that operates in that timeframe for user action is the holding down of the power button for four or five seconds to cause a system reset (reboot).

Controls such as keys are to be distinguishable through touch, such as the marks on some keyboard keys and the layout of number pads. Power controls are generally separated from other ones to avoid accidental use, and in some cases (like rocker switches) are of unique form. However, tactile markings could reduce the ambiguity in locating power controls.

"Toggle controls" on a device are to indicate their status by both "visual means and by touch or sound". This suggests that standards should exist for what a depressed power button means, and for each possible transition (sleep buttons are always non-mechanical). By convention, a power switch is *on* when depressed, which unfortunately conflicts with the comonpopulation stereotype of down meaning *off*. A switch which remains depressed to indicate its state is problematic if the mode can be changed by means other than pressing the switch, such as automatic controls. One way around this is for the switch state to change automatically (some copiers move their on/off switch position when an auto-off transition occurs; others require that the switch be moved to off then back to on to turn it back on again).

"The use of an image will be consistent throughout an application". This probably refers to icons, but generally supports the assertion that a consistent user interface is better for any user.

System startup and restart need not be accessible. This derives from the statement that "The advisory committee also recommended that system startup and restart be accessible, however, the Board has not included that provision in the proposed rule since no measurable standards were recommended." The likely focus of this is the "boot-up" process of a PC; for practical and technical reasons, making these generally accessible (e.g. through audio) would be difficult.

Use ascending and descending tones to show that a switch is turned on or off. This provision was not described with power controls in mind, but could be readily extended to them. With power controls, there is also a *sleep* mode between *on* and *off* on many devices that should be included. In addressing the accessibility of power indicators to the blind, a guide from the Access Board notes that when a PC is *on* the fan is running, and when a disk is accessed it can be heard spinning.

4.0 Other Data Sources

Curtis Chong, Director of Technology for the National Federation of the Blind, provided several insights on the phone and in a paper (Chong, 1996). Some points of his aare already described under the Section 508 discussion and are not repeated in this section.

Many blind people use noise and vibration of PCs and other electronic devices to assess their power state. Manufacturers are trying to reduce or eliminate these signals so that they may be unavailable to the blind in future. Replacements for these (unintended but useful) indications are needed. A helpful facility for the blind is a "test button" which when pressed would indicate the current power state without changing it.

It is desirable to clearly identify power state transitions. One pattern to adopt could be a high tone for a transition to *on*, and a low tone for a transition to *off*. A variant of this is the convention adopted by elevators, which beep once for going up and twice for going down.

An important resource for accessibility generally is the Trace Research and Development Center at the University of Wisconsin. Among their publications we found several useful items. Raised lettering as on keys should be at least 1/32" in height (0.8 mm). Release times (e.g for pressing a key) that are less than 1.5 seconds can be problematic (thus, the 4-5 seconds typical for holding a power button to cause a system reset seems OK). A table of movement stereotypes shows for *On*: up, right, forward, clockwise, pull; and for *Off*: down, left, rearward, counterclockwise, push. *Raise* is up and back; *lower* is down and forward (there is thus an inconsistency on forward/back between *on* and *up*). The flicker cutoff that they recommend is no faster than 5 Hz.

5.0 Conclusions and Recommendations

Based on all this, we don't see a problem for accessibility with the user interface standard as it stands. It would be desirable if there were more ways for the standard to address accessibility, but we simply did not find them on products, or receive them as suggestions from qualified people. Specific conclusions are:

- Use the color specifications in Appendix IV to reduce green/yellow (and yellow/red) confusion among the color-deficient.
- Power controls should be identified with a raised "nib" as found on many "F", "J" and "5" keys. We did not find a mechanical specification of how these should be constructed other than one that they should be at least 1/32" (about 0.8 mm) high. Several existing products (at least one TV and a TV remote from a different manufacturer) use three nibs in a row on their power buttons, but in the absence of more compelling evidence, we recommend a single nib on a power button, or on the "on" side of a power rocker switch.
- Use movement stereotypes for *on* and *off*, particularly up and down respectively. This applies to the physical layout of rocker and toggle switches, and to terminology.
- Provide for optional audio transitions of power states, either with a rising or high tone for on, or a falling or low tone for off. If only simple tones are available, use one for going to *on*, two for going to *off*, or three for going to *sleep* (the first two from practice with elevators).

6.0 References

Chong, Curtis, "Commercial Technology for the Blind", The Braille Monitor, Publication Of The National Federation Of The Blind, June, 1996.

IEC 1996. Basic and safety principles for man-machine interface, marking and identification — Coding principles for indication devices and actuators. IEC 73. Draft, Geneva, Switzerland: International Electrotechnical Commission. 1996.