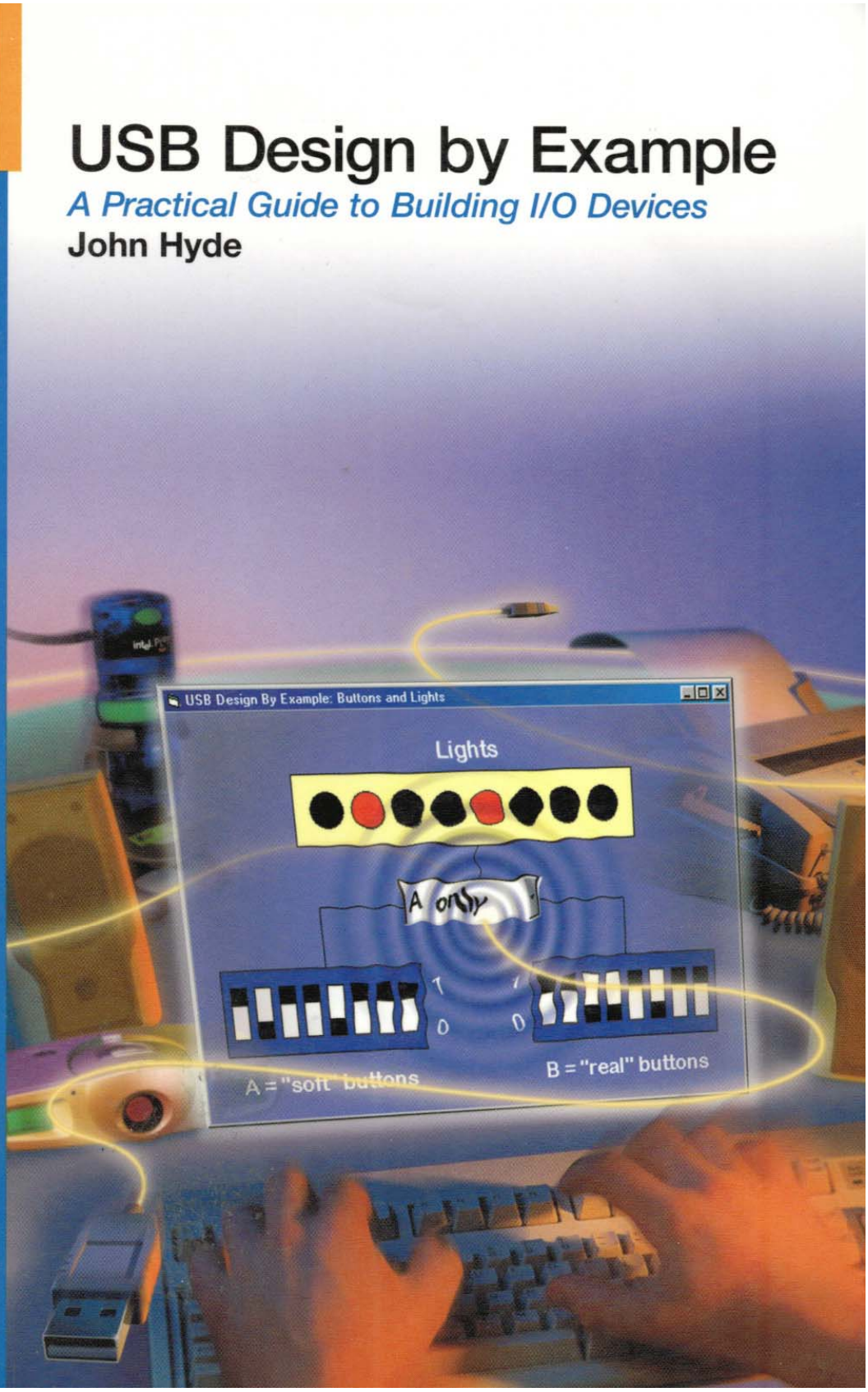
USB Design by Example

A Practical Guide to Building I/O Devices

John Hyde

Intel University Press

The PC Platform Designers' Choice



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CHAPTER 1
ADDING I/O DEVICES TO A MODERN PC

The personal computer (PC) has been around for a long time, in computer years. The first IBM PC was announced in 1981, and since then we've all wanted to add hardware to our PCs. The power of the PC has grown—the number of tasks we want the PC to do has grown—and the number of devices we want to connect to the PC has grown. But until recently there has been a practical limit to the number of available ports one could connect devices to.

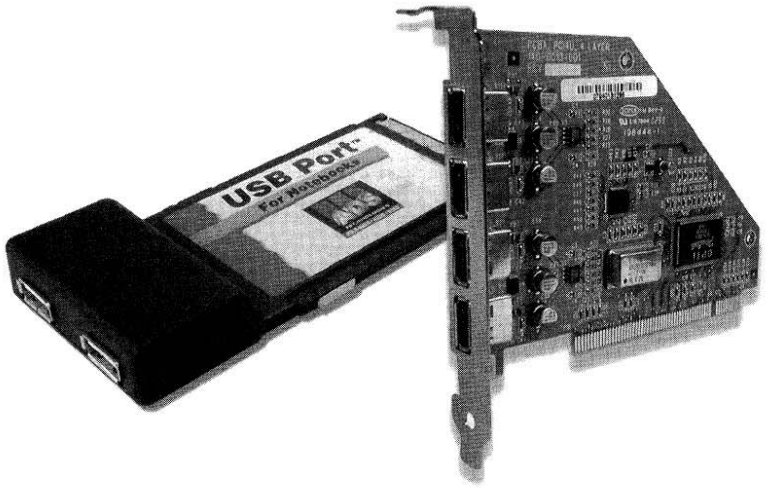
Enter the Universal Serial Bus, USB. You may have heard USB referred to as "the best thing" to happen to the personal computer for some time. The list of USB features is impressive:

- Hot-pluggable: I/O devices can be added while the PC is running.
- Ease of use: I/O device attachment is recognized by the PC and appropriate device drivers, and configuration is done automatically.
- Single connector type: all devices plug into the same socket type.
- High performance: 12 Mbps is much faster than existing serial and parallel ports.
- Up to 127 devices: there is no practical limit to I/O device expandability.
- Power supplied by cable: most devices will not need an additional power source.
- Power management: devices automatically power down when not in use.
- Error detection and recovery: errors are detected and transactions are retried to ensure that data is delivered reliably.
- External to the PC: there is no need to open the PC or design cards that must be installed in the PC.

Acknowledging the benefits of USB and designing an I/O device interface are two different things, however. Until now, you've had only the USB Specification to read for technical details. A specification by its nature usually provides few if any implementation examples. So, even after reading the specification, you still might not know how to design a simple I/O port for USB, let alone design a telephone or a camera-based I/O device.

CHAPTER SUMMARY

The Universal Serial Bus (USB) was the result of a tremendous amount of cooperative industry effort, and its inclusion and operating system support in a PC defines a modern PC. If your old notebook or desktop PC does not have USB sockets, these can be added via a PCMCIA card or a PCI card (see examples in Figure 1-13).



Courtesy of ADS Technologies, Inc. (left) and Entrega Technologies, Inc. (right).

Figure 1-13. Adding USB capability to a PC host

The PC host software is layered and interfaces are defined to allow the simple addition of application programs. The higher up the USB software stack we go, the farther we are from the actual I/O devices we are controlling. This abstraction allows the software and hardware to be developed on different schedules by different people. The hardware and software communicate via standardized interfaces that have the added benefit that they can be either swapped-out or upgraded independently. This new freedom will promote more diverse uses of the PC platform.