MICROCONTROLLERS

What is a microcontroller? Have you ever wondered how a guided missile reaches its target or how your refrigerator knows when to initiate a defrost cycle? What controls your microwave oven, digital video recorder, washing machine, and watch? Many common appliances and machines are controlled by embedded microcontrollers. A **microcontroller** is a special-purpose microprocessor that is built into the machine it controls. A microcontroller, such as the one in Figure 1-22, is sometimes called a computer-on-a-chip or an embedded computer because it includes many of the elements common to computers.

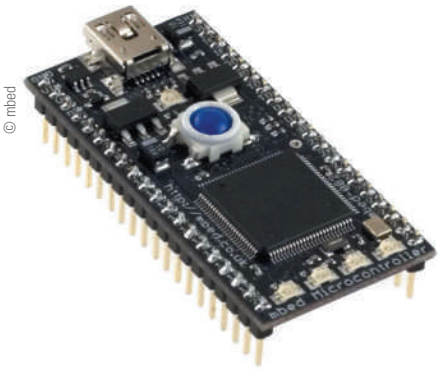

FIGURE 1-22

A microcontroller is a self-contained chip that can be embedded in an appliance, vehicle, or other device.

How does a microcontroller work? Consider the microcontroller in a Sub-Zero refrigerator. It accepts user input for desired temperatures in the refrigerator and freezer compartments. It stores these desired temperatures in memory. Temperature sensors collect additional input of the actual temperatures. The microcontroller processes the input data by comparing the actual temperature to the desired temperature. As output, the microcontroller sends signals to activate the cooling motor as necessary. It also generates a digital readout of the refrigerator and freezer temperatures.

Is a microcontroller really a computer? Recall that a computer is defined as a multipurpose device that accepts input, produces output, stores data, and processes it according to a stored program. A microcontroller seems to fit the input, processing, output, and storage criteria that define computers. Some microcontrollers can even be reprogrammed to perform different tasks.

Technically, a microcontroller could be classified as a computer. Despite this technicality, however, microcontrollers tend to be referred to as processors rather than as computers because in practice they are used for dedicated applications, not as multipurpose devices.

TRY IT!

Which one of the following would you most likely use to add and use apps such as games and weather tracking?

- ❍ A microcontroller
- ❍ Any handheld digital device
- ❍ A handheld computer

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Why are microcontrollers significant? Microcontrollers can be embedded in all sorts of everyday devices, enabling machines to perform sophisticated tasks that require awareness and feedback from the environment (Figure 1-23).

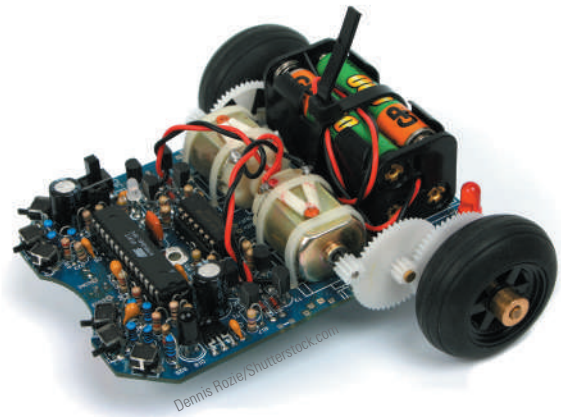

FIGURE 1-23

A microcontroller is usually mounted on a circuit board and then installed in a machine or an appliance using wires to carry input and output signals.

TRY IT!

Where's the microcontroller in this figure? Click it to see if you're right.

When combined with wireless networks, devices with embedded processors can relay information to Web sites, cell phones, and a variety of data collection devices. Machines and appliances with embedded processors tend to be smarter about their use of resources—such as electricity and water—which makes them environmentally friendly.

Perhaps the most significant effect of microcontrollers is that they are an almost invisible technology, one that doesn't require much adaptation or learning on the part of the people who interact with microcontrolled devices. However, because microcontrollers remain mostly out of sight and out of mind, it is easy for their use to creep into areas that could be detrimental to quality of life, privacy, and freedom.

The GPS chip in your cell phone, for example, can be useful if you're lost and need 911 assistance, but it could potentially be used by marketers, law enforcement, and others who want to track your location without your consent.

QuickCheck

SECTION B

1. A computer is a digital device that processes data according to a series of _____ instructions called a program or software.
2. Computer data is temporarily stored in _____, but is usually transferred to _____ where it can be left on a more permanent basis.
3. _____ computers are available in desktop and portable models.
4. A digital device, such as a computer, is called a(n) _____ when it requests data from a server.
5. A(n) _____ is a special-purpose microprocessor that is built into the machine it controls.

CHECK ANSWERS

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