Chapter XI

A Practical Introduction to Input and Output Ports

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Abstract

This chapter discusses how microprocessors interact with devices. It takes the student from the basics of input and output, through the design of the interface between a processor and an external device, and concludes with a discussion of how to improve the performance of the I/O interface using interrupts. The PC parallel port is examined to give the student a chance to apply these concepts in hardware and software. Once the student has studied the material of this chapter and completed the hands-on experiments, they will be prepared to begin a study of how device drivers work within the context of an operating system.

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Learning Objectives

After completing this chapter, you will be able to:

- Describe the interaction between a processor, bus, and I/O devices.
- Explain how operating systems use I/O to access a computer’s resources.
- Define the following key terms: device interface, digital logic probe, IC, and I/O ports.
- Suggest further enhancements to the materials presented in the chapter.

Introduction

Although the typical desktop computer has evolved into a stand-alone device, isolated from its environment except for a keyboard, a monitor, and a connection to a network, many computer applications still exist where the processor is used to control devices or read data from external processes or events. Outputs are needed for actions as simple as starting or stopping a process or as complex as positioning a robotic arm. Inputs are needed to monitor sensors ranging in capability from a simple switch to high-frequency analog input sampling circuitry. The discipline of sampling signals from the physical world so that the data can be analyzed or processed by a computer is called data acquisition (DAQ).

There are two types of input and output (I/O) signals associated with computer systems: analog and digital. Digital signals are usually associated with binary control, levels that can be either on or off. In some cases, however, they can be associated with scaleable input or output values. A stepper motor, for example, is a digitally controlled motor, the position of which can be controlled with binary outputs from a processor. There are also digital position encoders that can provide a processor with the position of a rotating shaft using digital patterns of ones and zeros.

An analog signal is a value read from the physical world such as temperature or pressure. A device called an analog-to-digital converter (ADC) measures the analog signal and sends a numeric representation of the measurement to the processor. The process of reading an analog signal has a number of issues regarding accuracy and timing. These issues are beyond the scope of this chapter though.

Even the basic desktop machine depends on I/O for its operation. The processor must be able to transfer data to and from devices such as a hard drive or a flash...
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