Chapter 9
I/O System Design

Objectives
- Memory-mapped I/O
- Parallel data transfer
- Serial data transfer
- The basics of memory-mapped video

Introduction
- We saw how to design memory system previously
- I/O peripherals are interfaced through the same kind of address decoders
- Decoders are used to map peripheral registers

Memory-Mapped I/O
- Normally, a memory location is to store important information
- Through memory-mapped I/O, we use it to communicate with outside
- Address decoder is required

Memory-Mapped I/O – Circuitry and Address Decoder

Memory-Mapped I/O – 8-Digit Alphanumeric Display
Parallel Data Transfer: the 6821 PIA

Serial Data Transfer: the 6850 ACIA
- Serial I/O needs a small number of wires between two points, while at the same time being very reliable
- Disadvantage: slow
- We can place our communication devices far away from each other

Programming the 6821 – Programmer’s Model and Control Register Bit Assignment

Interfacing the 6821

Serial Data Transfer: Standard TTL Serial Data Waveform
Programming the 6850 - Programmer's Model and Control Register (Ex. 9.1)

Memory-Mapped Video I/O: the 6845 CRT Controller

- Memory-mapped video: take an electronic snapshot of the contents of memory and display the information on a single display
- Digital circuitry to store and generate the image is needed to accomplish many complex tasks to correctly generate the video image
The 6845 CRT Controller – Pins Layout and Internal Block Diagram

The 6845 CRT Controller – Format of Memory-Mapped Video Word

The 6845 CRT Controller – Video RAM Contents for a Horizontal Line

Troubleshooting Techniques
- Write a short loop to test the I/O
- Check for easily overlooked mistakes
- Verify the enable signals on the I/O device all go to their active states when accessed
- For a serial device, examine the serial output for activity