Microprocessor Systems

Networks and Embedded Systems

First Grade Level

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Microprocessor Systems (1)

• Microprocessor System
Microprocessor Systems (2)

- Microcontroller / System on a Chip (SoC)

![Microcontroller System Diagram]
Microprocessor Systems (3)

- Microprocessor

![Diagram of microprocessor system components]
Microprocessor Systems (4)

• Information Flow
Memory (1)

• Memory Access

Microprocessor

Address = 002h

Data = 4

Write = 1

Microprocessor

Address = 002h

Data = 4

Read = 1

Compiler stuff (not in storage)
Memory (2)

• Memory Hierarchy
  – Motto: the faster the smaller
  – Data is copied between different hierarchies
  – Heavily used data is close to the microprocessor

Registers
- Superfast
- Very expensive
- Tiny

Cache
- Very fast
- Expensive
- Small

Main Memory
- Fast
- Moderate
- Reasonable

Secondary Memory
- Slow
- Cheap
- Large
Peripherals (1)

• Examples
  – Computers
    • Storage: hard disk drive, SSD
    • Input devices: keyboard, mouse
    • Output devices: monitor, printer, speaker
  – Mobile Phone
    • Storage: flash, SD memory card
    • Input devices: touch screen, camera
    • Further devices: accelerometer, GPS
Peripherals (2)

• Characteristics
  – Independent devices
    • Have their own controller
    • Have their own register set
  – Data exchange necessary
    • Host/Device connection
    • Connected via interface
  – Operate asynchronously
    • Device acts independently from host
Peripherals (3)

- Architecture

![Diagram showing the relationship between software and hardware layers, including Operating System, Device Driver, Peripheral, Registers, Controller, Data, Control, Status]
Peripherals (4)

• Register Set
  – Data Register
    • Used to transfer data to and from the device
      Example: the text a printer should print
  – Control Register
    • Tells the device what to do
      Example: print out a color copy
  – Status Register
    • Reports what the device is doing
      Example: printer has stopped as it is out of paper
Peripherals (5)

• Communication
  – Polling
    • Device is polled if it is ready to receive data
    • Device is polled if new data is available
Peripherals (6)

• Communication (continued)
  – Interrupt
    • Device indicates that it is ready to receive data
    • Device indicates that new data is available

![Diagram of host and device with an indicator line and a triangle symbol indicating readiness]
Development Boards (1)

• Basic Idea
  – Prototype board
    • Concept testing
  – Components
    • Microcontroller
    • Power supply
    • Pin breakout
    • Connection to Host
    • Status indicators
Development Boards (2)

• Example: DOIT Esp32 Devkit V1