

嵌入式微處理機系統

06_Bus-Based Computer Systems

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The Embedded computing platform

- CPU bus.
- Memory.
- I/O devices.



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CPU bus

- Connects CPU to:
 - memory;
 - devices.
- Protocol controls communication between entities.



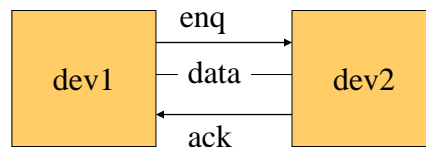
Bus protocol

- Determines who gets to use the bus at any particular time.
- Governs length, style of communication.

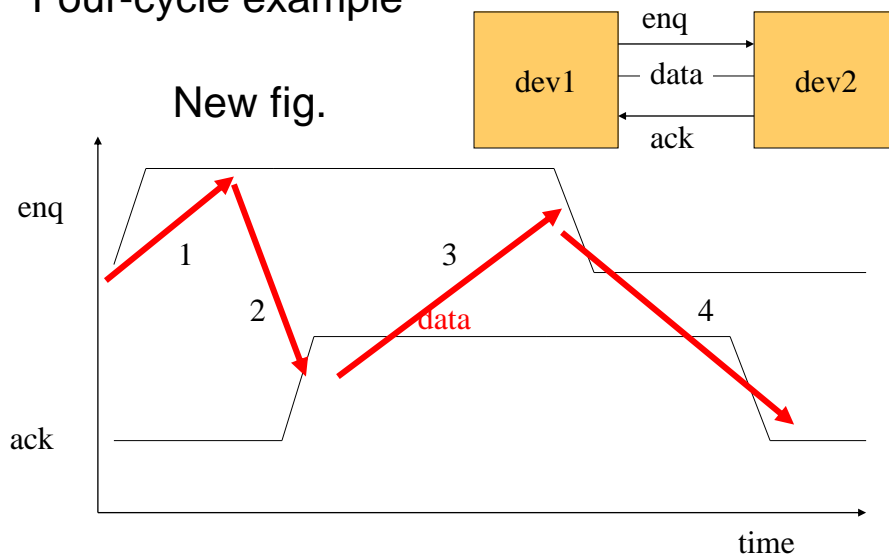


Four-cycle handshake

- Basis of many bus protocols.
- Uses two wires:
 - **enq** (enquiry);
 - **ack** (acknowledgment).



Four-cycle example

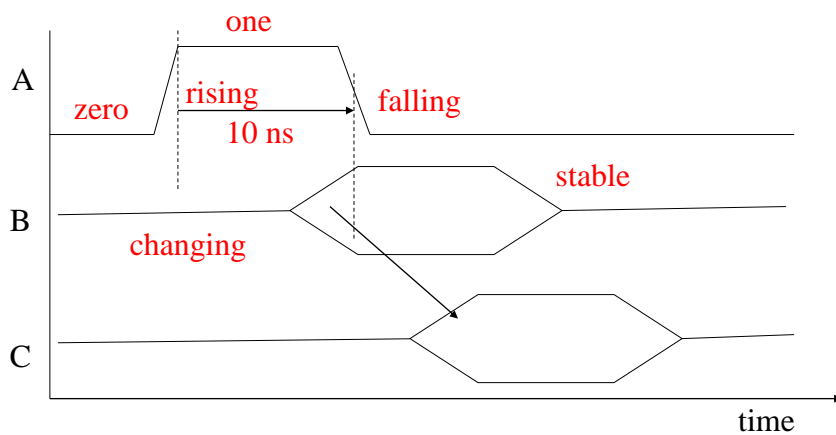


Typical bus signals

- **Clock.**
- **R/W'**: true when bus is reading.
- **Address**: a-bit bundle.
- **Data**: n-bit bundle.
- **Data ready'**.



Timing diagrams



Typical bus timing for read

● CPU:

- set $R/W'=1$;
- asserts address, address enable.

● Memory:

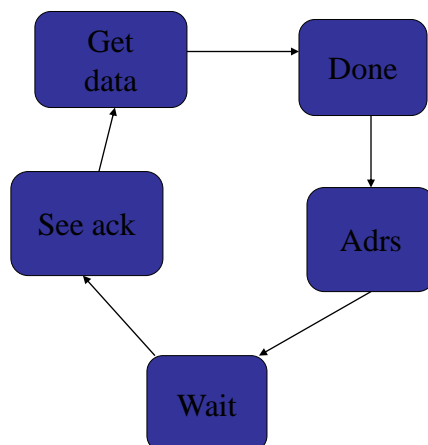
- asserts data;
- asserts data ready'.

● CPU:

- deasserts address, address enable.



Bus read state diagram



Transaction types

- Wait state:
 - state in a bus transaction to wait for acknowledgment.
- Disconnected transfer:
 - bus is freed during wait state.
- Burst:
 - multiple transfers.



Timers and counters

- Very similar:
 - a **timer** is incremented by a periodic signal;
 - a **counter** is incremented by an asynchronous, occasional signal.
- Rollover causes interrupt.



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- New page (fig. 4-7)
 - New fig.



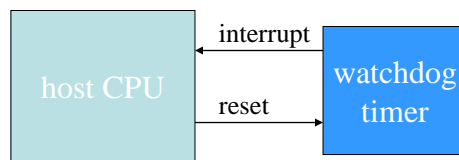
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- New page (fig. 4-8)



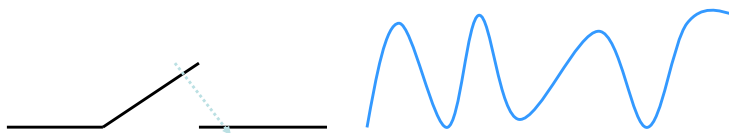
Watchdog timer

- Watchdog timer is periodically reset by system timer.
- If watchdog is not reset, it generates an interrupt to reset the host.



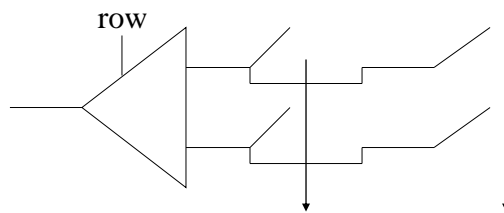
Switch debouncing

- A switch must be debounced to multiple contacts caused by eliminate mechanical bouncing:



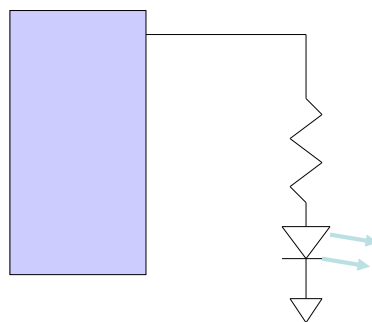
Encoded keyboard

- An array of switches is read by an encoder.
- **N-key rollover** remembers multiple key depressions.



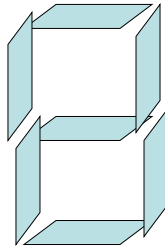
LED

- Must use resistor to limit current:



7-segment LCD display

- May use parallel or multiplexed input.



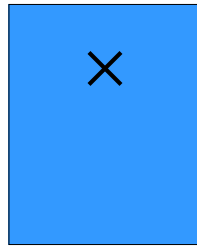
Types of high-resolution display

- Cathode ray tube (CRT)
- Liquid crystal display (LCD)
- Plasma, etc.

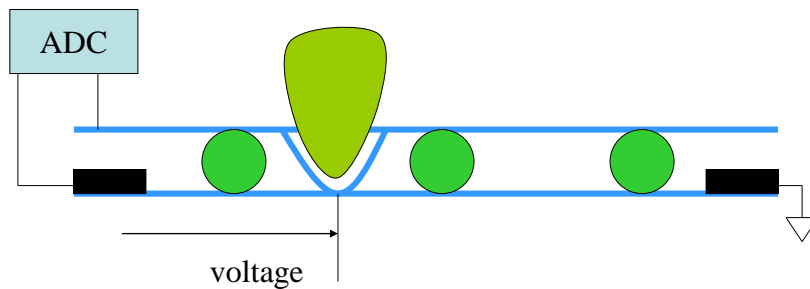


Touchscreen

- Includes input and output device.
- Input device is a two-dimensional voltmeter:

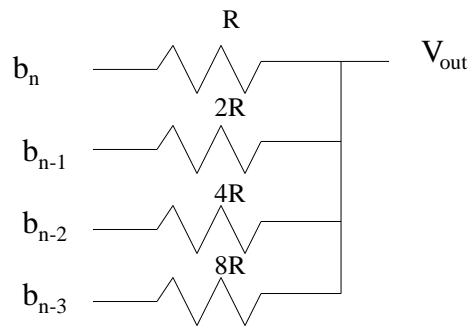


Touchscreen position sensing



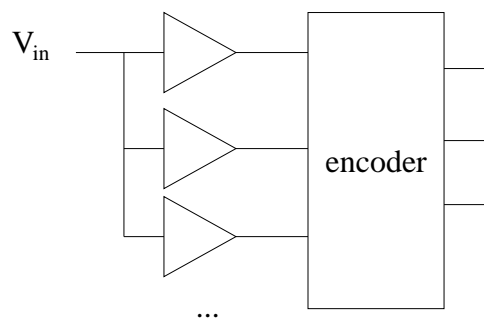
Digital-to-analog conversion

- Use resistor tree:



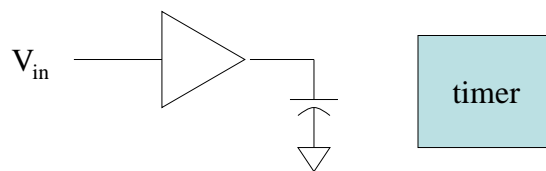
Flash A/D conversion

- N-bit result requires 2^n comparators:



Dual-slope conversion

- Use counter to time required to charge/discharge capacitor.
- Charging, then discharging eliminates non-linearities.



Sample-and-hold

- Required in any A/D:

