Temperature sensor on flash memory-microcontroller

- ECE 298 Fall 2004
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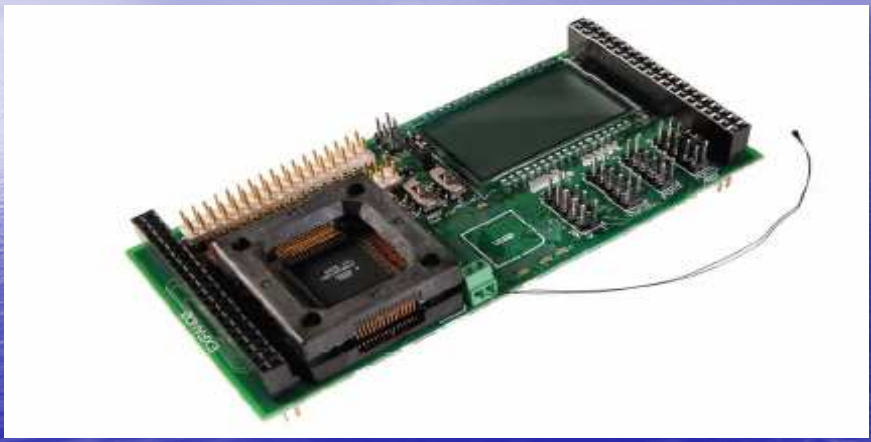
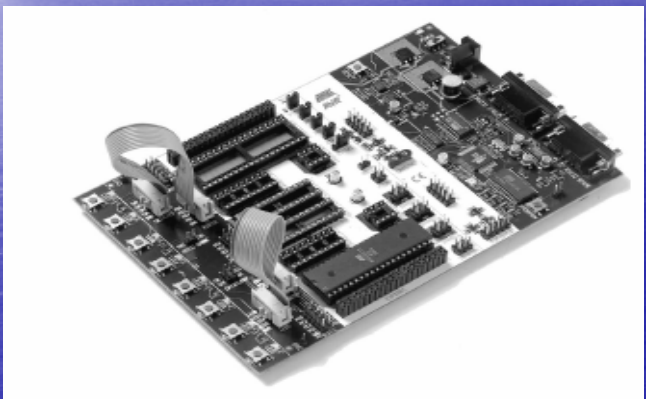
Preview of Presentation:

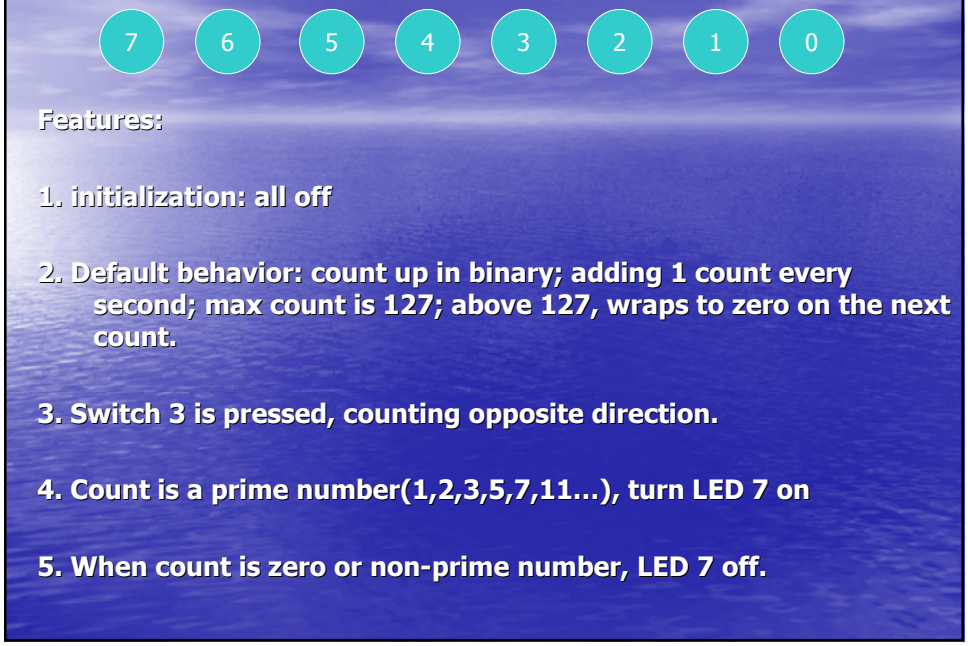
1. Demo. A: Temperature sensor
2. Demo. B: Interrupt controlled LEDs
3. Microcontroller in general
4. ATMEL, AVR microcontroller
5. Design Approaches
6. Conclusion

Demo A: Temperature Sensor



Presentation B: LEDs





3. Why we pick up this topic?

1. Embedded system is everywhere, embedded microcontroller is key component
2. With the emergence of internet, network, wireless technology, microcontroller finds a bigger application field than ever.

The difference between a microcontroller and microprocessor? ?

3.1 Answer to previous question:

- Microcontroller = Microprocessor + Memory + I/O
- A microcontroller is a self contained computer-on-a-chip consisting of
  - -central processing unit
  - -nonvolatile program memory
  - -random access memory
  - -various input-output capabilities

3.2 Types of Microcontroller:

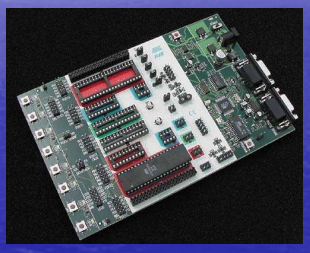
- **4-bit**
  -lack the minimum performance and features
  -only used to basic functionality
- **8-bit**
  -most cost effective embedded control solution
  -Most popular one !!
- **16-bit & 32 bit**
  -high performance
  -expensive for high volume embedded control applications

3.3 Microcontrollers inside a typical modern car:

Application	Type of microcontroller	Total Numbers
Engine control	32-bit	1
Transmission Audio system Anti-lock breaking	16-bit	3
Door locking Automatic windows Sun roof Air bags Fuel pump…	8-bit	50

3.4 Top companies with world market share for 8-bit microcontroller

- Microchip
- Motorola
- ST-Micro
- NEC
- Atmel



4.1 ATMEL AVR 8-bit microcontroller

- High performance, low power AVR 8-bit microcontroller
- Advanced RISC Architecture
  -130 powerful instructions-Most single clock cycle execution
  -32x8 general purpose working register
- Non-volatile program and data memories
  -16K bytes of in-system self-programmable flash; endurance: 10,000 write/erase cycles

CONT....

- Peripheral Features
  -4x25 segment LCD Driver
  -Two 8-bit timer/counters
  -One 16-bit timer/counters
  -8-channel, 10-bit ADC
  -programmable serial USART
  -interrupt and wake up on pin change

5.1 Design Approaches & Lessons Software Architecture

- Real Time Operating System (RTOS)
- Round-Robin
- Round-Robin with Interrupts

5.2 ROTS Approach

- Many advanced embedded systems
- But, AVR 169 has ONLY 16 K bytes flash memory. Too small to handle any ROTS

5.3.1 Round-Robin (Polling)

- Main loop simply checks each of the I/O devices and services any that need service
- Advantage: simplicity
- Disadvantage:
  1. waste processor computing time
  2. No priority in multiple I/O devices

5.3.2 Round-Robin (Polling)

```
void main (void)

{
    for (; ; ;)
    {
      // regular functions

      if ( I/O Device A needs service)
      {
        // take of device A
      }

      if ( I/O Device B needs
        service)
        {
          // take of device B
        }

        etc.
        etc.
    }
}
```

5.4.1 Round-Robin with Interrupts

- Configure the I/O to raise an interrupt request
- Main loop pools the flags and does follow-up processing
- Advantage:

  1. Save processor time
  2. Priority can be applied

5.4 Round-Robin with Interrupts

```
Bool DevA = false;
Bool DevB = false;

Void interrupt Device A
   (void)
   {
      // functions
      DevA = true;
   }

   Void interrupt Device B (void)
   {
      // functions
      DevB = true;
   }
```

```
   etc.

void main (void)
{
   for(; ; ;)
   {
         if (DevA)
         // take of device A

         if (DevB)
         // take of device B
   }
}
```

6.1 Conclusion:

Biggest Lessons:

1. How to use manuals efficiently and effectively
2. Up to 1,000 pages manual; only read related necessary one

6.2 Conclusion

- Microcontrollers is one the largest segments of the semiconductor market
- Embedded microcontroller is a fundamental component in any kind of technologies.

References:

- Text books:

  -Computer organization, fifth edition, by Carl Hamacher, Zvonko Vranesic, Safwat Zaky

  -An embedded software primer, by David E. Simon

  -The art of designing embedded systems, by Jack Ganssle

- ATMEL manual

The End

Thank you!!