Why "Smart Products"?
Focuses on Microcomputers as Components not Controllers
Encompasses Mechatronics

What Makes Mechatronics Different?
Intelligent Decision Making
The Ability to adapt
Cost Effectiveness

What Makes these Decisions?
Computers
Number Representations

Binary
10101010

Hexadecimal
$AA

Converting
10101010
$ A A

Number Terminology

Integer
Word

Modulo Arithmetic

\[
\begin{align*}
11111111 + 1 & = 00000000 \\
00000000 - 1 & = 11111111
\end{align*}
\]
What’s A

Microprocessor?

Micro-Computer?

Micro-Controller?

Micro-Computer Components

CPU

Program Memory

Scratchpad Memory

Input/Output (I/O)
Instructions to the microprocessor. Often referred to as 'Machine Language'.

Data
Generally we put this there during the operation of our programs.

Control Registers
These occupy space like memory, but are actually special locations that interact directly with the hardware of the microprocessor.

Ports
A subset of the control registers. Ports generally offer direct control of the pins on the microprocessor.
Program Memory Options

MROM
PROM
  EPROM
    Eraseable
    OTP
  EEPROM (or $E^2$PROM)
  FLASH EPROM

Scratchpad Memory Options

Static RAM
  Battery Back-up
Dynamic RAM
Cache RAM

What Features Will You Find?

Parallel I/O
  Programmable
  Fixed Direction
What Features Will You Find?

Counters

Timers
  Simple
  Complex
  Outrageously Complex

What Features Will You Find?

Serial I/O
  Synchronous
  Asynchronous

What Features Will You Find?

A/D Converters
  8 - Bit
  10 - Bit
  Multi-Channel
What Features Will You Find?

D/A Converters
  PWM

What Differentiates Micro-Controllers?

  Feature Sets
  Architecture
  Physical Size
  Cost

The Motorola 68HC11

  Hi-Performance 8 - Bit Controller
  8 - Bit Data Bus
  Supports Hi-Level Languages
  Comes in over 45 'Flavors'
68HC11 Memory

16 Bit Address Bus
   64K (65536) Byte Address Space
8 Bit Data Bus

2K (2048) Bytes EEPROM
256 Bytes RAM

68HC11 Parallel I/O

8 Bi-Directional Lines
8 Fixed Output Lines

68HC11 Timer System

16 Bit Free-Running Counter
Input Captures (3)
Output Compares (4)
68HC11 Pulse Accumulator

- 8 bits
- Interrupt on Overflow

68HC11 Serial I/O

- SPI (synchronous)
- SCI (asynchronous)

68HC11 A/D Converter

- 8 bit (1:256) Resolution
- 8 Channels
- 2 banks of 4
The Development Process

Your Project

PC (Development Computer)

MPL (Target Computer)

68HC11

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