Course Overview

URL: http://www.ee.nmt.edu/~erives/classes.php

Texts:

- Class Notes
- Freescale Databooks on the MC9S12
- The HCS12/9S12: An Introduction to Software and Interfacing, 2nd Edition by Han-Way Huang

Grading:

- 10%: Homework
- 10%: Quizzes (given regularly every Friday)
- 45%: Three midterms exams
- 10%: Final exam
- 25%: Laboratory grade

Late work will have a 25% penalty. Need to pass the Laboratory to be able to pass the course.
• Introduction to the MC9S12 Microcontroller

• Binary and Hexadecimal Numbers

• Assembly Language Programming

• C Language Programming

• Introduction to MC9S12 Internal Peripherals
  – The MC9S12 Timer Subsystem
  – Interrupts using the Timer Subsystem
  – The MC9S12 Pulse Width Modulator Subsystem

• The MC9S12 Expanded Mode
  – Address and Data Buses and Timing
  – Adding Memory and External Peripherals
  – Interfacing to the MC9S12

• More MC9S12 Internal Peripherals
  – The A/D Converter Subsystem
  – The Serial Peripheral Interface
  – The Serial Communications Interface

• Using the MC9S12 in a Control Application
Lab Overview

• The lab meets Monday and Tuesdays afternoons. **No labs this week.**

• Lab handouts will be posted starting the following week.

• The 9S12 evaluation kits will be passed out in lab next week.

• **You need to bring a bound lab notebook to the first lab.**

• There will be a prelab for each lab. This must be done and turned in at the start of your lab section. The lab TA will verify that you have completed the prelab.

• Be prepared to answer questions about the pre-lab when you come to lab.

• If you do not complete the prelab before coming to lab, you will lose a high percentage of the points for that lab.
• Introduction to Microprocessors and Microcontrollers.
  
  o Course Overview
  o Cruise Control Block Diagrams and Flowchart
  o Block Diagrams of Simple Microprocessor and Microcontroller
  o Harvard architecture and Princeton architecture microprocessor block diagrams
  o Memory map for a Princeton architecture microprocessor

AUTOMOBILE CRUISE CONTROL

MEASURE SPEED

SET DESIRED SPEED

CONTROL

THROTTLE
$\Delta T$ = time for one revolution of wheel.  
**Speed** = $C/\Delta T$, where $C$ is the circumference of the wheel.
START

CC ON? (Diamond)

YES

READ ΔT

SA = C/ΔT

READ SD

G = G + K(SD - SA)

NO

READ MANUAL THROTTLE

G = MT
MICROCONTROLLER

SIMPLE MICROPROCESSOR
<table>
<thead>
<tr>
<th>INSTRUCTION</th>
<th>ACTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>18 06</td>
<td>(A) + (B) ⇒ A</td>
</tr>
<tr>
<td>87</td>
<td>0 ⇒ A</td>
</tr>
<tr>
<td>5A 05</td>
<td>(A) ⇒ Address 5</td>
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HARVARD ARCHITECTURE
MICROPROCESSOR

DATA MEMORY —— DATA & ADDR —— ALU —— CONTROL —— STATUS —— CLOCK

IN

OUT

INSTRUCTION MEMORY —— INSTRUCTION

CONTROL MEMORY —— CONTROL
PRINCETON (VON NEUMAN) ARCHITECTURE

MICROPROCESSOR

MEMORY

INSTRUCTION

DATA

IN

OUT

ALU

CONTROL

CONTROL & ADDR

STATUS

CLOCK
MEMORY MAP
(Princeton Architecture)

Function of memory determined by programmer

PROGRAM

DATA
Figure 2-1. Programming Model

<table>
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<tr>
<th>Binary</th>
<th>Hex</th>
<th>Decimal</th>
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<tr>
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<td>10</td>
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<tr>
<td>1100</td>
<td>C</td>
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<tr>
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<td>D</td>
<td>13</td>
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<tr>
<td>1110</td>
<td>E</td>
<td>14</td>
</tr>
<tr>
<td>1111</td>
<td>F</td>
<td>15</td>
</tr>
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</table>
Convert Binary to Decimal

1111011_2

1 x 2^6 + 1 x 2^5 + 1 x 2^4 + 1 x 2^3 + 0 x 2^2 + 1 x 2^1 + 1 x 2^0

1 x 64 + 1 x 32 + 1 x 16 + 1 x 8 + 0 x 4 + 1 x 2 + 1 x 1

123_{10}

Convert Hex to Decimal

82D6_{16}

8 x 16^3 + 2 x 16^2 + 13 x 16^1 + 6 x 16^0

8 x 4096 + 2 x 256 + 13 x 16 + 6 x 1

33494_{10}