

Homework 2

MechatronicsII

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Problems

What numbers (e.g. range) can a byte (8 bits) and an integer (16 bits) describe?

A byte, consisting of 8 bits can describe $2^8 = 256$ unique numbers. If the byte is signed the range is $\{-128..127\}$ but if the byte is unsigned the range is $\{0..255\}$. Similarly a 16 bit integer can describe 2^{16} different numbers. If the integer is signed the range is $\{-32,768..32,767\}$ but an unsigned integer covers the range $\{0..65535\}$

Write the bit pattern (e.g. hex) for the integer 1962_D (D for Decimal)

$$1962_D = 1024 + 512 + 256 + 128 + 32 + 8 + 2 = 2^{10} + 2^9 + 2^8 + 2^7 + 2^5 + 2^3 + 2^1 = 0000\ 0111\ 1010\ 1010_B$$

Write the bit pattern (e.g. hex) for the byte -13D

First find the bit pattern for $13_D = 0000\ 1101_B$ then use 2's compliment to get:
 $-13_D = 1111\ 0010_B + 1_B = 1111\ 0011_B$

Write the bit pattern (e.g. hex) for the single precision number 1,0D

The sign bit is 0, the exponent bits are $E = 127_D = 0111\ 1111_B$ and the mantissa is 0 giving:
 $1.0_D = 0011\ 1111\ 1000\ 0000\ 0000\ 0000\ 0000\ 0000_B = 3f80\ 0000_H$

And together bitwise the bitpatterns 0x55 and 0xAA

$$55_H \& AA_H = 0101\ 0101_B \& 1010\ 1010_B = 0000\ 0000 = 00_H$$

OR together the bitpatterns 0x55 and 0xAA

$$55_H \parallel AA_H = 0101\ 0101_B \parallel 1010\ 1010_B = 1111\ 1111_B = FF_H$$

Add together 0x55 and 0xAA

$$\text{in hexadecimal notation: } 55 + AA = 10 * (A + 5) + (A + 5) = 10 * F + F = FF$$

Subtract 0x55 from 0xAA

$$\text{In hexadecimal notation: } AA - 55 = 10 * (A - 5) + (A - 5) = 10 * 5 + 5 = 55$$

Write the bit pattern for ASCII symbol „A“

From the ASCII table it can be read that „A“ has the hexadecimal code 41_H , thus has the bit pattern $0100\ 0001_B$

Show how do we define an signed 8-bit integer in C (not using any library)?

On most systems a char is signed but not always so to make sure we should explicitly define it as signed: `signed char a;`

Explain the AVR assembler command **BREQ**

BREQ stand for **Branch if Equal** it is a conditional branch. It compares two values and if they are equal it sends the program execution to a certain location, else it does nothing.

Make a block diagram of your project

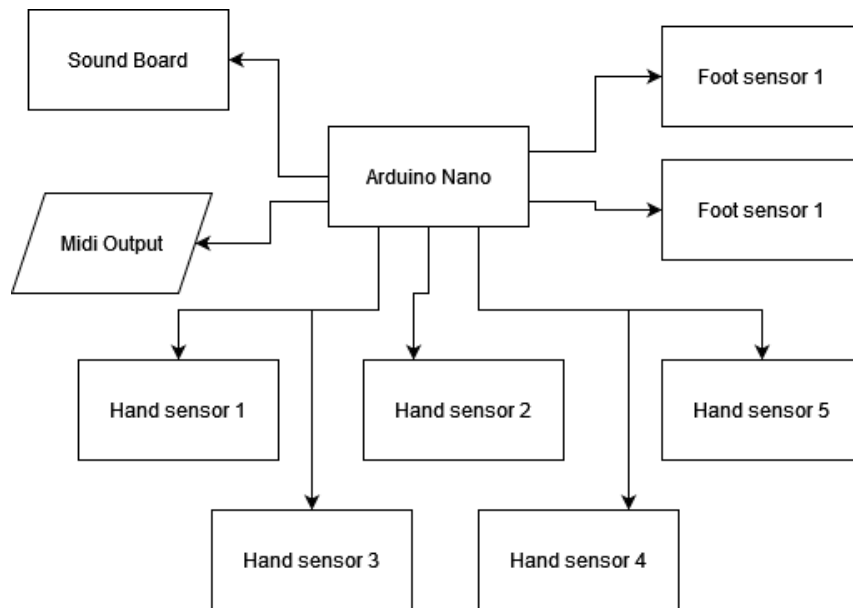


Figure 1: Block diagram of the **AirDrums**

Final Project

This week I researched options for sensors.

- For hand sensors (sensing when the hand strikes the thigh) my main 2 options are Piezo Contact Microphones and Accelerometers.
- For the right foot sensor I am considering using an accelerometer mounted on the toe of the shoe, I theorize that it should experience a spike in acceleration when the foot strikes the ground.
- For the left foot sensor I am also considering using an accelerometer. The left foot needs to sense the actual position of the foot since that controls the sound from the HiHats.

Next week I intend to source some simple accelerometers with analog outputs and some piezo contact microphones and test them out, try to measure the signal to noise ratio.