Bion

Sensor network:
- 1000 sensor nodes
- 3 miles of telephone cable

Wilhelm Reich
Project 1: Digital I/O and Timing

• Control of LEDs and Speaker
• Respond to button presses
Part 1

- Internal 4-bit (software) counter
- Counter state is reflected by the LEDs
  - Bit 0: Blue
  - Bit 1: Yellow
  - Bit 2: Red
  - Bit 3: Green
- Each button press: increment counter
  - Update LED display
Part 2

• Generate tone with the speaker
  – Different tone for each counter state (higher tones for higher values)
  – Produce tone as long as the button is being pressed

• Speaker is controlled by a digital I/O line
  – So: in one of two states
  – Tones are produced by generating a “square wave” at a given frequency
Project Administrivia

Due in one week (Feb 27\textsuperscript{th})

- Demonstrate to me, Gareth, or Di
- Documented code:
  - Hand-in on D2L
  - One copy per 2-person group
- Personal report: distribution of work
  - One per person
  - Hand in on D2L
Bion Care

• Hold bions on the side of the board (don’t touch the components)
• Minimize the bending of the components
• Don’t let the bion come in contact with metal while it is powered on

• If things get hot: disconnect power immediately and ask for help
Getting Started

See: http://www.cs.ou.edu/~fagg/classes/general/atmel/

Summary:

• (perhaps) Install AVRstudio
• (perhaps) Install WinAVR
• Plug the programmer into your computer
• Plug the programmer into the bion
• Plug the power into the bion
• Create a program
Project Menu: New Project

Create new project

Project type:
- Atmel AVR Assembler
- AVR GCC

Project name:
- firstproject

Location:
- Z:\projects\archive\symbiotic\microcontroller\atmel\examples\firstproject\
Project Menu: Configuration Options

General:
- Use External Makefile
  1. Target name must equal project name.
  2. Clean/rebuild support requires "clean" target.
  3. Makefile and target must exist in the same folder.

Output File Name: firstproject.elf
Output File Directory: default

Device: atmega32
Frequency: Hz
Optimization: -O0

Create Hex File
Generate Map File
Generate List File
```c
#include "oulib.h"

int main(void)
{
    DDRB = 7;

    while(1) {
        PORTB = 1;
        delay_ms(500);
        PORTB = 0;
    }
}
```
Add oulib.c and oulib.h to the Source Files and Header Files, respectively.
#include "oulib.h"

int main(void)
{
    DDRB = 7;

    while(1) {
        PORTB = 1;
        delay_ms(500);
        PORTB = 0;
        delay_ms(500);
    }
}
Build menu: Build

```c
{    
    DDRB = 7;   
    while(1) {    
        PORTB = 1;    
        delay_ms(500);    
        PORTB = 0;    
        delay_ms(500);    
    }   
}
```
You should get this
Now We Are Ready…

• Plug the programmer into the bion (if it is not already)
• Power up the bion
• And download the program…
  – Tools Menu: AVR: Connect
Physical Interface for Programming
AVR ISP
Physical Interface for Programming

AVR ISP

USB connection to your laptop
Physical Interface for Programming

AVR ISP

Header connection will connect to your circuit (through an adapter)

Be careful when you plug your circuit in (check before powering)
AVR ISPs are Cranky

• When things are plugged in and powered, you should see two green LEDs on the ISP
• One red: usually means that your circuit is not powered
• Orange: the programmer is confused
  – Could be due to your circuit not being powered at 5V
  – Could be due to other problems
  – Check power and reboot the ISP
int main(void)
{
    DDRB = 7;
    while(1) {
        PORTB = 1;
        delay_ms(500);
        PORTB = 0;
        delay_ms(500);
    }
}

Tip: To auto-connect to the programmer used last time, press the 'Programmer' button on the toolbar.

Note that the JTAGICE cannot be used for programming as long as it is connected in a debugging session. In that case, select 'Stop Debugging' first.

-eeprom --set-section-flags=.eeprom="alloc,load" --change-section-lma .eeprom=0 -0 ihex firstproject.elf firstproject.eep

6 bytes (39.4% Full)
+ .bootloader)

6 bytes (1.6% Full)
+ .noinit)
You should only have to do this once
Select your program (a .hex file)
Flashing?

Your program will start executing as soon as the download is complete …

Your green Light Emitting Diode should be blinking at 1 Hertz (once per second)