Embedded System Laboratory Course

Dr. Fangning Hu

Protected: Lab 3 – Blink LED in C Program

Introduction:

Now we are going to introduce you how to write C program for the microcontroller and control the LEDs. In order to use the predefined register names, delay functions, and interrupt vector names, you need to include the following header files:

```
#include <avr/io.h>
#define F_CPU 16000000UL        //Define CPU clock as 16Mhz
#include <util/delay.h>
#include <avr/interrupt.h>
```

You may find the description of the libraries <avr/io.h> <util/delay.h> <avr/interrupt.h> at the online document

http://www.nongnu.org/avr-libc/user-manual/modules.html

You may start your main function as follow:

```
int main(void)
{

DDRD = 0xFF;

//add yourcodes here
}
```

The interrupt service routine are written as follow:

```
ISR(XXX_vect)
{
//add your codes here
}
```

where XXX is the interrupt vector names defined in the datasheet chapter 12.4.

You need to use the command sei() to enable any interrupt and cli() to disable any interrupt.

To create a new C project in Atmel Studio,

You need to select the Atmega328 as a target device!!

PreLab Tasks:

- Read the AVR C Programming Basic in my Introduction Chapter and get familiar with the logic operation such as <<, &, |, ~, ^, etc.

- Read the ATmega328 datasheet (Chapter I/O ports andChapter External Interrupts) and understand the concept of DDRx, PORTx, PINx, INT0, EIMSK, EICRA. (If you already know it from the previous labs, you can skip this step).
- Find out to how to write a C command to have 1 second delay in the description of <util/delay.h>at the online document http://www.nongnu.org/avr-libc/user-manual/modules.html
- Find the interrupt vector names for External Interrupt 0 and External Interrupt 1 in the datasheet chapter 12.4.

Lab Assignments:

1. Connect 3 LEDs to PORTD and make them blink half second one after another continuously (you need to use the delay function to produce the half second delay).

2. Triggering an external interrupt by a pressing button, after pressing the button, all the 3 LEDs blink three times simultaneously.

3. Debug your code in Atmel Studio and you will see a Deassembly window.

Lab Report: The requirements are the same as the previous lab.