Lab 8

Part 1: Reading the Datasheet

The Wunderboard runs on an Atmel AT90USB1287. The datasheet for that can be found off the lab webpage. The Atmel chip works based on many 8-bit registers. The list of all of the registers starts on page 419. This list is long and intimidating. However, we will not use most of these registers in this class. In addition, the datasheet clearly details all registers. For example, on page 89:

PORTA – Port A Data Register

Bit	7	6	5	4	3	2	1	0	
	PORTA7	PORTA6	PORTA5	PORTA4	PORTA3	PORTA2	PORTA1	PORTA0	PORTA
Read/write	R/W	R/W	R/W	R/W	R/W	R/W	R/W	R/W	
Initial value	0	0	0	0	0	0	0	0	

PORTA is the register name. The programmer can use register names as 8-bit variables.

Example:

```
int x = 5, y;
PORTA = x;
y = PORTA;
assert(x == y);
```

PORTA0 is a bit name. The programmer can use bit names like numbers. The number is always equal to the location of the bit.

Example:

```
int x = 5;
assert(x == PORTA5);
```

This is useful.

Exercise: Do the following bitwise calculations and write the answer in 8-bit binary

1. **(1<<PORTA0) = 0b00000001**
2. **(1<<PORTA3) =**
3. **(1<<PORTA6)|(1<<PORTA2) =**

This way, the programmer can specify individual bits in a register.

Another register, UCSRnA is on page 194.

UCSRnA – USART Control and Status Register A

Bit	7	6	5	4	3	2	1	0	
	RXCn	TXCn	UDREn	FEn	DORn	UPEn	U2Xn	MPCMn	UCSRnA
Read/write	R	R/W	R	R	R	R	R/W	R/W	
Initial value	0	0	1	0	0	0	0	0	

There are a few things different about this register.

1. UCSRnA does not exist. Every register or bit name with a lower case ‘n’ in it, needs to be replaced with a number. For example, UCSR1A exists and has the bit TXC1 in it.
2. Some bits are read-only, such as FEn. The ‘R’ underneath the box denotes this.
3. Different bits start with different values when the Wunderboard turns on. For example: UDREn starts as a 1 and U2Xn starts as a 0.
4. Some groups of bits are referred to as UCSZn[2:0]. This is the same as UCSZn2, UCSZn1, and UCSZn0.
5. Each bit in some registers have detailed descriptions of each bit. For example:
   - **Bit 5 – UDREn: USART Data Register Empty**

   The UDREn Flag indicates if the transmit buffer (UDRn) is ready to receive new data. If UDREn is one, the buffer is empty, and therefore ready to be written. The UDREn Flag can generate a Data Register Empty interrupt (see description of the UDRIEn bit).

   UDREn is set after a reset to indicate that the Transmitter is ready.
6. Some bits have behavior defined in tables. The tables detail the value for each bit to get a certain setting. For example:

Table 19-7. UCSZn bits settings.

UCSZn2	UCSZn1	UCSZn0	Character size
0	0	0	5-bit
0	0	1	6-bit
0	1	0	7-bit
0	1	1	8-bit
1	0	0	Reserved
1	0	1	Reserved
1	1	0	Reserved
1	1	1	9-bit

7. “Reserved” bits, registers, and settings are not available for use by the programmer.

Exercise: Complete the following using the datasheet

Use a find or search tool in the pdf to find the chart for SPCR.

1. Which bit is SPE?

2. What does SPE stand for?

3. What is the initial value of CPOL?

4. Can you write to CPHA?

5. What is the result of the following lines of code in English (not numbers)?

   a.
```
SPCR |= ((1<<SPE)|(1<<SPIE));
```

   b.
```
SPCR &= ~(1<<SPE);
```

   c.
```
if(SPCR&(1<<MSTR)){
    SPCR |= (1<<SPIE);
}
else{
    SPCR &= ~(1<<SPIE);
}
```