EE-222: Microprocessor Systems

AVR Microcontroller:
I/O Ports Bit Manipulation

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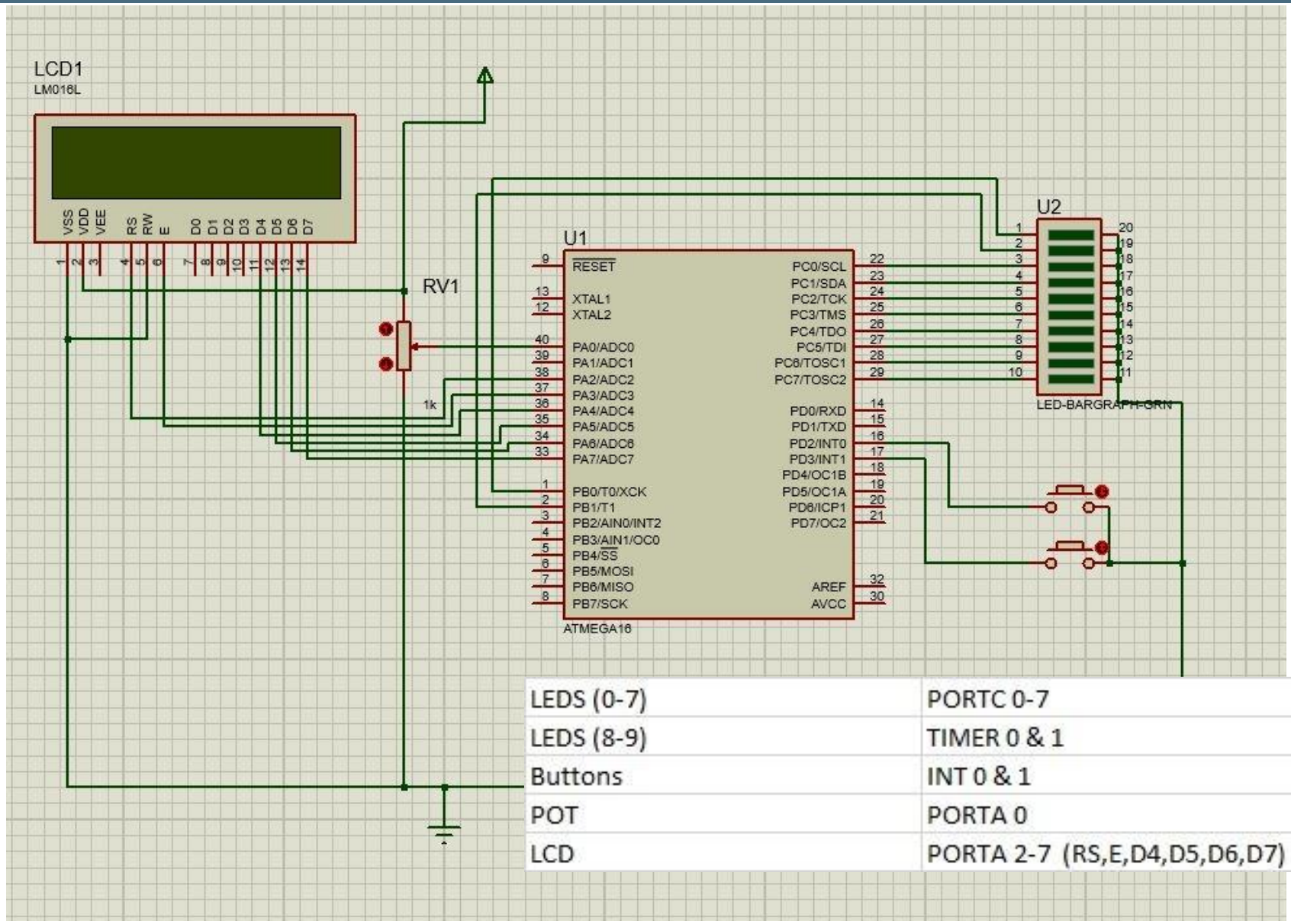
My Demo Board



LEDS (0-7)	PORTC 0-7
LEDS (8-9)	TIMER 0 & 1
Buttons	INT 0 & 1
POT	PORTA 0
LCD	PORTA 2-7 (RS,E,D4,D5,D6,D7)

I/O Ports Bit Manipulation

SBI and CBI instructions

- SBI (Set Bit in IO register)
  - SBI ioReg, bit ;ioReg.bit = 1
  - Examples:
    - SBI PORTD,0 ;PORTD.0 = 1
    - SBI DDRC,5 ;DDRC.5 = 1

- CBI (Clear Bit in IO register)
  - CBI ioReg, bit ;ioReg.bit = 0
  - Examples:
    - CBI PORTD,0 ;PORTD.0 = 0
    - CBI DDRC,5 ;DDRC.5 = 0

Example

- Write a program that toggles PORTB.4 continuously.

```
     SBI   DDRB,4
L1:  SBI   PORTB,4
     CBI   PORTB,4
     RJMP  L1
```

Example

- An LED is connected to each pin of Port D. Write a program to turn on each LED from pin D0 to pin D7. Call a delay module before turning on the next LED.

```
        LDI     R20, 0xFF
        OUT     DDRD, R20          ;make PORTD an output port
        SBI     PORTD,0            ;set bit PD0
        CALL    DELAY              ;delay before next one
        SBI     PORTD,1            ;turn on PD1
        CALL    DELAY              ;delay before next one
        SBI     PORTD,2            ;turn on PD2
        CALL    DELAY
        SBI     PORTD,3
        CALL    DELAY
        SBI     PORTD,4
        CALL    DELAY
        SBI     PORTD,5
        CALL    DELAY
        SBI     PORTD,6
        CALL    DELAY
        SBI     PORTD,7
        CALL    DELAY
```

SBIC and SBIS

- SBIC (Skip if Bit in IO register Cleared)
  - SBIC ioReg, bit ; if (ioReg.bit = 0) skip next instruction
  - Example:

```
SBIC   PORTD,0   ;skip next instruction if PORTD.0=0
INC    R20
LDI    R19,0x23
```

- SBIS (Skip if Bit in IO register Set)
  - SBIS ioReg, bit ; if (ioReg.bit = 1) skip next instruction
  - Example:

```
SBIS   PORTD,0   ;skip next instruction if PORTD.0=1
INC    R20
LDI    R19,0x23
```

can only be used for any bits of the lower 32 I/O registers

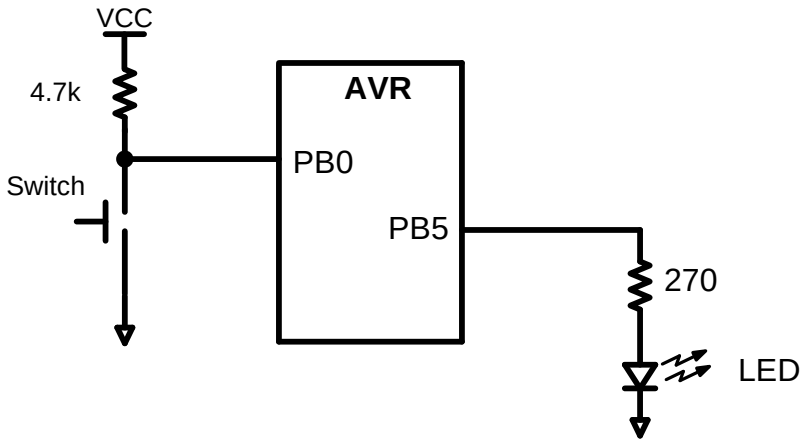
Example

- Write a program to perform the following:
- (a) Keep monitoring the PB2 bit until it becomes HIGH;
- (b) When PB2 becomes HIGH, write value $45 to Port C, and also send a HIGH-to-LOW pulse to PD3.

```
        CBI   DDRB, 2       ;make PB2 an input
        SBI   PORTB,2
        LDI   R16, 0xFF
        OUT   DDRC, R16     ;make Port C an output port
        SBI   DDRD, 3       ;make PD3 an output
AGAIN:  SBIS  PINB, 2       ;Skip if Bit PB2 is HIGH
        RJMP  AGAIN         ;keep checking if LOW
        LDI   R16, 0x45
        OUT   PORTC, R16    ;write 0x45 to port C
        SBI   PORTD, 3      ;set bit PD3 (H-to-L)
        CBI   PORTD, 3      ;clear bit PD3
HERE:   RJMP  HERE
```

Example

- A switch is connected to pin PB0 and an LED to pin PB5. Write a program to get the status of SW and send it to the LED.




```
        CBI   DDRB,0        ;make PB0 an input
        SBI   DDRB,5        ;make PB5 an output
AGAIN:  SBIC  PINB,0        ;skip next if PB0 is clear
        RJMP  OVER          ;(JMP is OK too)
        CBI   PORTB,5
        RJMP  AGAIN         ;we can use JMP too
OVER:   SBI   PORTB,5
        RJMP  AGAIN         ;we can use JMP too
```

THANK YOU