MSP430 ADC with LCD Display

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1 Aim

To read an analog voltage using the MSP430 ADC and display the digital result on an LCD.

2 Theory

The MSP430 ADC10 module converts an analog signal into a 10-bit digital value. The LCD is driven in 4-bit mode to display the measured value.

3 Source Code

Listing 1: ADC with LCD Code

```c
#include <msp430.h>
#include <string.h>

int a=0;
unsigned int ADC_Result;
volatile long int m1,i;
void Initialize_gpio_lcd();
void wd(char n, int mode);

char l,m,p;
int hundreds, tens, ones, j;

int main(void)
{
    WDTCTL = WDTPW | WDTHOLD;
    Initialize_gpio_lcd();

    P1DIR |= BIT0;
    P1OUT &= ~BIT0;

    SYSCFG2 |= ADCPCTL0;
    PM5CTL0 &= ~LOCKLPM5;

    ADCCTL0 |= ADCSHT_2 | ADCON;
```

```c
25        ADCCTL1  |= ADCSHP;
26        ADCCTL2  |= ADCRES;
27        ADCMCTL0 |= ADCINCH_0;
28        ADCIE  |= ADCIE0;
29
30        while(1)
31        {
32            ADCCTL0  |= ADCENC | ADCSC;
33            __bis_SR_register(LPM0_bits | GIE);
34            if (ADC_Result < 0x1FF)
35                P1OUT  &= ~BIT0;
36            else
37                P1OUT  |= BIT0;
38            __delay_cycles(5000);
39        }
40        wd(0x01,1);
41 }
42
43 #pragma vector=ADC_VECTOR
44 __interrupt void ADC_ISR(void)
45 {
46        wd(0x80,1);
47        wd(0x06,1);
48
49        ADC_Result = ADCMEM0;
50        j = ADC_Result;
51
52        ones = j % 10; j /= 10;
53        tens = j % 10; j /= 10;
54        hundreds = j;
55
56        p = hundreds | 0x30;  wd(p,0);
57        m = tens | 0x30;      wd(m,0);
58        l = ones | 0x30;      wd(l,0);
59
60        __bic_SR_register_on_exit(LPM0_bits);
61 }
62
63 /* LCD helper functions */
64 void Initialize_gpio_lcd()
65 {
66        P2DIR |= (BIT0 | BIT1 | BIT5 | BIT6);
67        P3DIR |= (BIT1 | BIT2);
68        P2OUT |= (BIT0 | BIT1 | BIT5 | BIT6);
69        P3OUT |= (BIT1 | BIT2);
70        P2OUT |= BIT1;
71        for(m1=1000;m1!=0;m1--);
72        wd(0x03,1); for(m1=1000;m1!=0;m1--);
73        wd(0x02,1); for(m1=1000;m1!=0;m1--);
74        wd(0x28,1);
75        wd(0x01,1);
```

```
76      wd(0x0C,1);
77      wd(0x06,1);
78      wd(0x80,1);
79  }
80
81  void wd(char n, int mode)
82  {
83      int d0,d1,d2,d3,d4,d5,d6,d7;
84      d0 = n & 0x01; d1 = n & 0x02;
85      d2 = n & 0x04; d3 = n & 0x08;
86      d4 = n & 0x10; d5 = n & 0x20;
87      d6 = n & 0x40; d7 = n & 0x80;
88
89      for(m1=1000;m1!=0;m1--);
90      if (mode) P2OUT &= ~BIT0; else P2OUT |= BIT0;
91
92      if(d4) P3OUT |= BIT2; else P3OUT &= ~BIT2;
93      if(d5) P2OUT |= BIT6; else P2OUT &= ~BIT6;
94      if(d6) P2OUT |= BIT5; else P2OUT &= ~BIT5;
95      if(d7) P3OUT |= BIT1; else P3OUT &= ~BIT1;
96      for(m1=1000;m1!=0;m1--);
97      P2OUT |= BIT1; for(m1=1000;m1!=0;m1--); P2OUT &= ~BIT1;
98
99      if(d0) P3OUT |= BIT2; else P3OUT &= ~BIT2;
100     if(d1) P2OUT |= BIT6; else P2OUT &= ~BIT6;
101     if(d2) P2OUT |= BIT5; else P2OUT &= ~BIT5;
102     if(d3) P3OUT |= BIT1; else P3OUT &= ~BIT1;
103     for(m1=1000;m1!=0;m1--);
104     P2OUT |= BIT1; for(m1=1000;m1!=0;m1--); P2OUT &= ~BIT1;
105 }
```

4   Observation

The ADC converts the voltage at A0 to a 10-bit digital value and displays the result on the LCD. The LED at P1.0 lights up when the input is above approximately half of AVcc.

5   Conclusion

This lab demonstrates single-channel ADC operation with MSP430 and interfacing the result to an LCD in 4-bit mode.