

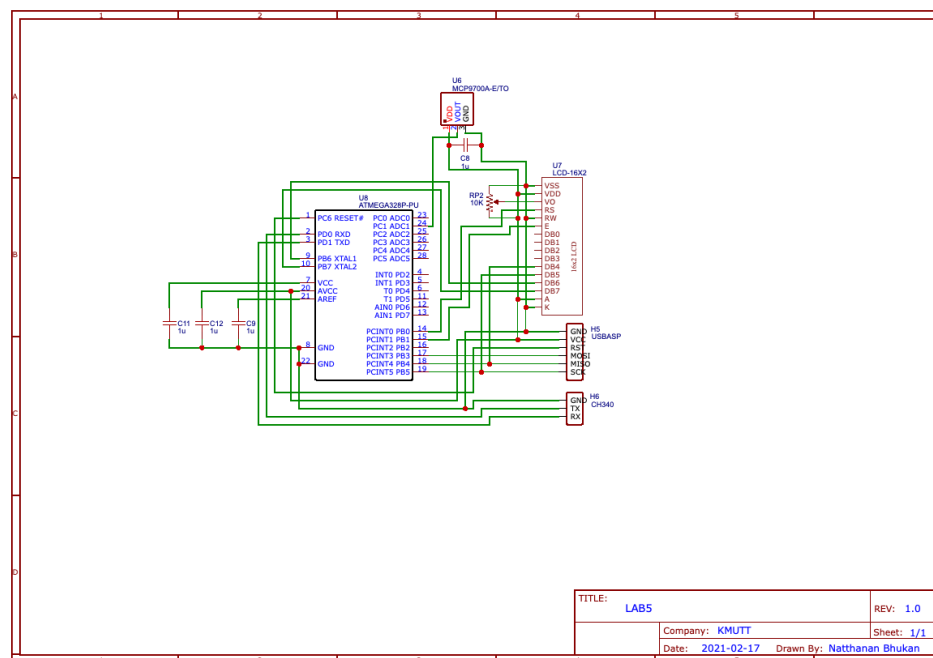


King Mongkut's University of Technology Thonburi
Faculty of Engineering, Department of Computer Engineering
CPE 328 Embedded System, 2/2020

LAB Lecture 5: Analog digital convertor

Assign Date: 17 Feb 2021 Due Date: 24 Feb 2021

Schematic Diagram



Code

```
#define F_CPU 8000000L
1
2 #include <avr/io.h>
3 #include <util/delay.h>
4 #include <stdio.h>
5 #include <string.h>
6 #include <stdlib.h>
7
8 #define LCD_Dir DDRB /* Define LCD data port direction */
9 #define LCD_Port PORTB /* Define LCD data port */
10 #define RS PB0 /* Define Register Select pin */
11 #define EN PB1 /* Define Enable signal pin */
12
13 void USART_Init(unsigned int ubrr) {
14     UBRRE0 = ubrr;
15     UCSRE0 |= (1 << RXEN0) | (1 << TXEN0);
16     UCSRE0 |= (1 << UCSZ01) | (1 << UCSZ00);
17 }
18
19 void USART_Transmit(unsigned char data) {
20     while (!(UCSR0A & (1 << UDRE0)));
21     UDR0 = data;
22 }
23
24 void print(unsigned char *buffer) {
25     for(int i=0; buffer[i] != 0; i++){
26         USART_Transmit(buffer[i]);
27     }
28 }
29
```



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```

1 void LCD_Command( unsigned char cmd )
2 {
3     LCD_Port = (LCD_Port & 0x0F) | (cmd & 0xF0); /* sending upper nibble */
4     LCD_Port &= ~ (1<<RS); /* RS=0, command reg. */
5     LCD_Port |= (1<<EN); /* Enable pulse */
6     _delay_us(1);
7     LCD_Port &= ~ (1<<EN);
8     _delay_us(200);
9     LCD_Port = (LCD_Port & 0x0F) | (cmd << 4); /* sending lower nibble */
10    LCD_Port |= (1<<EN);
11    _delay_us(1);
12    LCD_Port &= ~ (1<<EN);
13    _delay_ms(2);
14 }
15
16 void LCD_Char( unsigned char data )
17 {
18     LCD_Port = (LCD_Port & 0x0F) | (data & 0xF0); /* sending upper */
19     LCD_Port |= (1<<RS); /* RS=1, data reg. */
20     LCD_Port |= (1<<EN);
21     _delay_us(1);
22     LCD_Port &= ~ (1<<EN);
23     _delay_us(200);
24     LCD_Port = (LCD_Port & 0x0F) | (data << 4); /* sending lower */
25     LCD_Port |= (1<<EN);
26     _delay_us(1);
27     LCD_Port &= ~ (1<<EN);
28     _delay_ms(2);
29 }

```

```

1 void LCD_Init (void) /* LCD Initialize function */
2 {
3     LCD_Dir = 0xFF; /* Make LCD port direction as o/p */
4     _delay_ms(20); /* LCD Power ON delay always >15ms */
5     LCD_Command(0x02); /* send for 4 bit initialization of LCD */
6     LCD_Command(0x28); /* 2 line, 5*7 matrix in 4-bit mode */
7     LCD_Command(0x0c); /* Display on cursor off */
8     LCD_Command(0x06); /* Increment cursor (shift cursor to right) */
9     LCD_Command(0x01); /* Clear display screen */
10    _delay_ms(2);
11 }
12
13 void LCD_String (char *str) /* Send string to LCD function */
14 {
15     int i;
16     for(i=0; str[i]!=0 && str[i]!=0x000a; i++) /* Send each char of string till the NULL And String sh
17     {
18         LCD_Char(str[i]);
19     }
20 }
21
22 void LCD_Clear()
23 {
24     LCD_Command (0x01); /* Clear display */
25     _delay_ms(2);
26     LCD_Command (0x80); /* Cursor at home position */
27 }

```



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```

3 void LCD_Clear()
2 {
1   LCD_Command (0x01); /* Clear display */
2   delay_ms(2);
1   LCD_Command (0x80); /* Cursor at home position */
2 }
3
4 void ADC_Init(){
5   ADMUX |= (1 << REFS0) | (1 << MUX2) | (1 << MUX0); // Select the ADC channel and AVCC as
6   ADCSRA |= (1 << ADEN) | (1 << ADPS2) | (1 << ADPS1); // Select ADC Prescaler to 64
7   DIDR0 |= (1 << ADC5D);
8 }
9
10 uint16_t ADC_Read(){
11
12   ADCSRA |= (1 << ADSC); // Enable ADC and Start the conversion
13
14   while( !(ADCSRA & (1 << ADIF)) ); // Wait for interrupt
15
16   uint16_t d_out = ADC; // Copied ADC out already concatenate ADCL ADCH
17   ADCSRA |= (1 << ADIF); // Clear Flag
18   return d_out; // Return value
19 }
20

```

```

1 int main(void) {
14
1   USART_Init(53); /* Initialization of USART*/
2   ADC_Init(); /* Initialization of ADC*/
3   LCD_Init(); /* Initialization of LCD*/
4   LCD_Clear();
5   _delay_ms(1000);
6
7   uint16_t sensor;
8   float temp;
9   unsigned char text[] = "Temp = ";
10  unsigned char buffer[10];
11
12  while (1) {
13    sensor = ADC_Read(); /* Read data from sensor */
14    temp = (((sensor/1024.0) * 5) - 0.5) * 100.0 ;
15
16    dtostrf(temp, 4, 2, buffer);
17    strcat(buffer, " C\n");
18
19    print(text);
20    print(buffer);
21
22    LCD_Clear(); // Clear LCD
23    _delay_ms(100);
24    LCD_String(text); // Sent Message
25    LCD_String(buffer);
26
27    _delay_ms(1000);
28  }
29 }

```

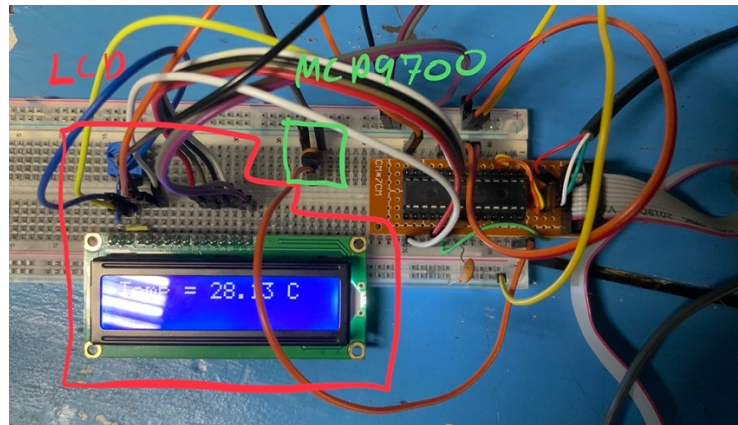


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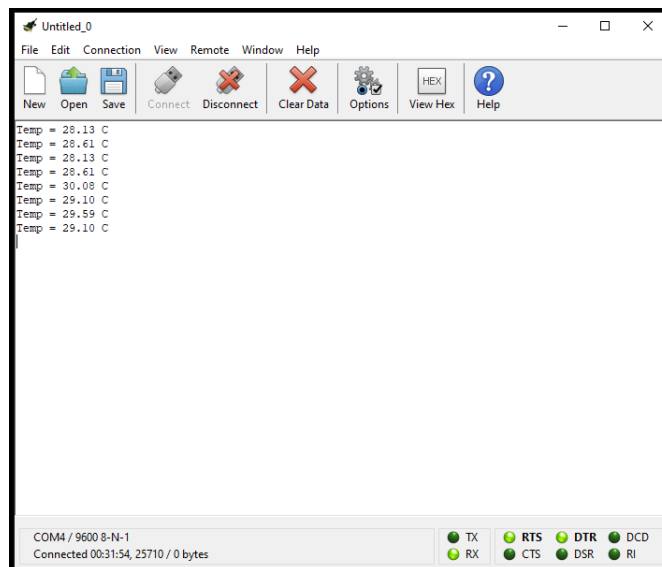
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On board



1. Connect a circuit with an ATmega328P and MCP9700A (analog temperature sensor) and write a program to transmit the current ambient temperature to your PC using a serial port

Result





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2. Extend your program to display the current ambient temperature on the 16x2 alphanumeric LCD display in addition to transmitting through the serial port

Result

