CPE301 – SPRING 2019

Design Assignment 3B

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Directory: /DesignAssignments/DA3B

Submit the following for all Labs:

1. In the document, for each task submit the modified or included code (only) with highlights and justifications of the modifications. Also, include the comments.
2. Use the previously create a Github repository with a random name (no CPE/301, Lastname, Firstname). Place all labs under the root folder ESD301/DA, sub-folder named LABXX, with one document and one video link file for each lab, place modified asm/c files named as LabXX-TYY.asm/c.
3. If multiple asm/c files or other libraries are used, create a folder LabXX-TYY and place these files inside the folder.
4. The folder should have a) Word document (see template), b) source code file(s) and other include files, c) text file with youtube video links (see template).

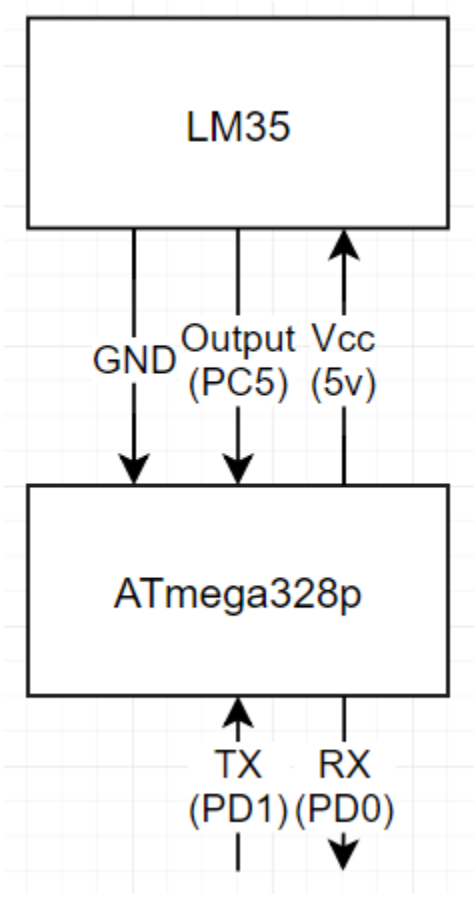
1. COMPONENTS LIST AND CONNECTION BLOCK DIAGRAM w/ PINS

List of Components used:

ATmega328p Xplained Mini

LM35 Temperature Sensor

Block diagram with pins used in the Atmega328P



2. INITIAL CODE OF TASK 1/A

```
#define F_CPU 16000000UL
#define PRESCALAR 1024
#define BAUDRATE 9600
#define BAUD_PRESCALAR (((F_CPU / (BAUDRATE * 16UL))) - 1)
#define ONESEC (0xFFFF - ((F_CPU/PRESCALAR)*1) - 26)
#include <avr/io.h>
#include <avr/interrupt.h>
#include <stdio.h>

void USART_init(void); // initializes USART settings
void USART_sendChar(char ch); // sends a character
void USART_sendString(char* str); // sends a string
void TIMER_init(void); // initializes timer sequence for interrupts

char num = '7'; // random number
char string[] = "Hello World!"; // basic string
float floating = 12.345; // random float value
char fl[20]; // character buffer for float value


int main(void)
{
	snprintf(fl,sizeof(fl),"%f\r\n",floating); // converts floating value into string
	USART_init(); // initialize USART
	TIMER_init(); // initialize Timer/Interrupt

	while (1) // Loop forever
	{
	}
}

void USART_init( void )
{
	UBRR0H = 0; // not needed
	UBRR0L = BAUD_PRESCALAR; // Baud Prescaler
	UCSR0C = _BV(UCSZ01) | _BV(UCSZ00); /* 8-bit data */
	UCSR0B = _BV(RXEN0) | _BV(TXEN0); /* Enable RX and TX */
}

void USART_sendChar(char ch) {
	while (!(UCSR0A & (1<<UDRE0))); // while data reg is not empty: hold
	UDR0 = ch; // place character into reg
}

void USART_sendString(char* str) {
	while ((*str != '\0')) { // while not the end of the string
		while (!(UCSR0A & (1<<UDRE0))); // while data reg is not empty: hold
		UDR0 = *str; //take in character to reg
		str++; // next character
	}
}

void TIMER_init(void) {
	TCNT1 = ONESEC; // ONESEC is the number to count up to 0xFFFF for 1 sec delay
	TIMSK1 |= (1 << TOIE0); // Enable Interrupt for Timer1
```

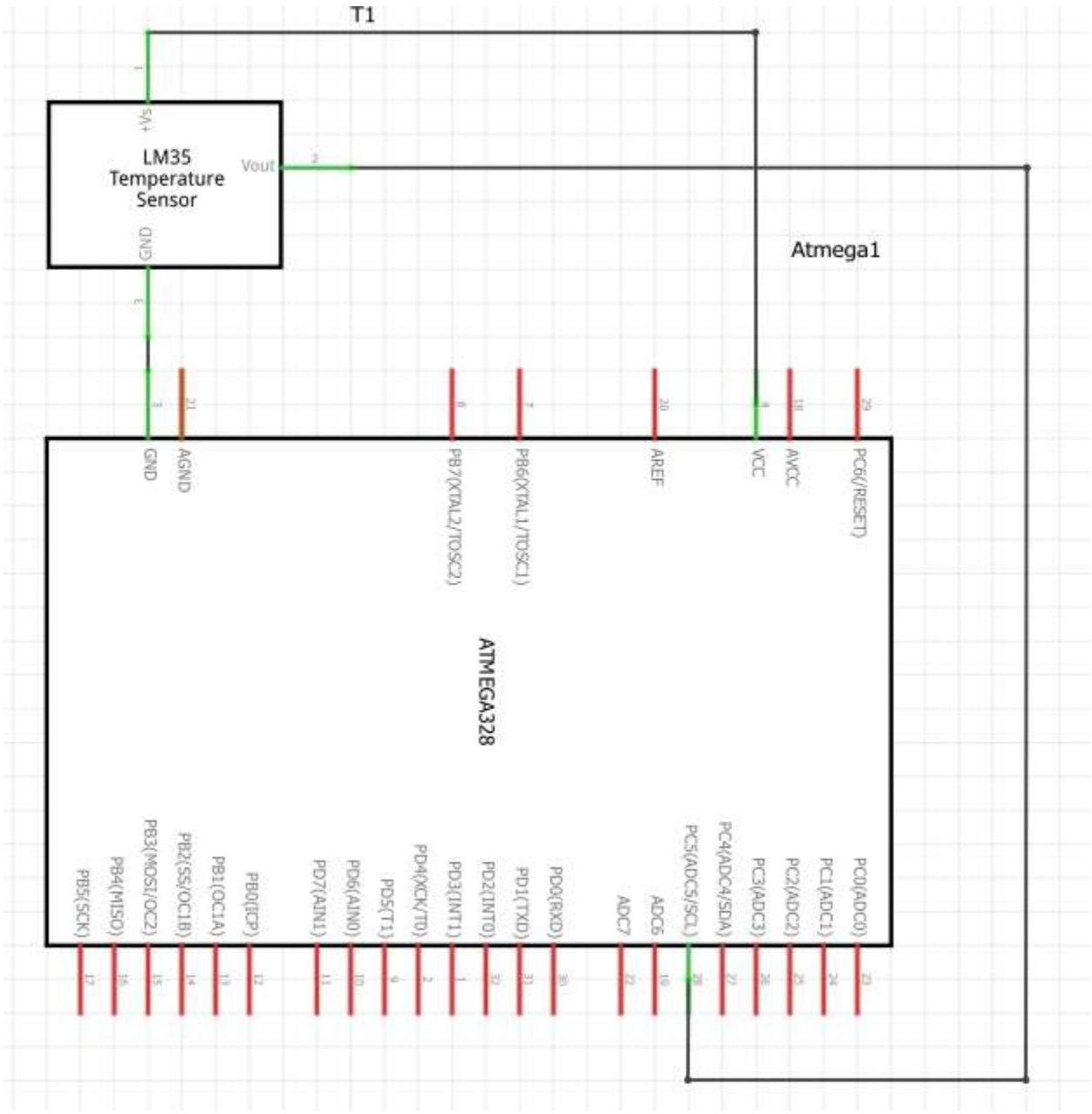
```
	sei(); // Enable Global Interrupt
	TCCR1B |= (1<<CS12)|(1<<CS10); // Start timer 1 and set prescaler to 1024
}

ISR (TIMER1_OVF_vect) {
	USART_sendChar(num); // send char '7'
	USART_sendString(string); // send "Hello World!"
	USART_sendString(fl); // send 12.345
	TCNT1 = ONESEC; // set the timer back
}
```

3. DEVELOPED MODIFIED CODE OF TASK 1/B from TASK 1/A

```
#define F_CPU 16000000UL
#define PRESCALAR 1024
#define BAUDRATE 9600
#define BAUD_PRESCALAR (((F_CPU / (BAUDRATE * 16UL))) - 1)
#define ONESEC (0xFFFF - ((F_CPU/PRESCALAR)*1) - 60)

#include <avr/io.h>
#include <avr/interrupt.h>
#include <stdio.h>

void USART_init(void); // initializes USART settings
void USART_sendChar(char ch); // sends a character
void USART_sendString(char* str); // sends a string
void TIMER_init(void); // initializes timer sequence for interrupts
void ADC_init(void); // initializes ADC settings

volatile int adc_temp;

int main(void)
{
	USART_init(); // initialize USART
	TIMER_init(); // initialize Timer/Interrupt
	ADC_init();

	while (1) // Loop forever
	{
	}
}

ISR (TIMER1_OVF_vect) {
	TCNT1 = ONESEC; // set the timer back
	ADCSRA |= (1<<ADSC); // start conversion
	while ((ADCSRA&(1<<ADIF))==0){} // Wait for conversion
	ADCSRA |= (1<<ADIF); // Clear Interrupt Flag

	adc_temp = ADCL; // take in lower bits first
	adc_temp = adc_temp | (ADCH<<8); // take in upper bits
	char temp[20]; // buffer
	snprintf(temp,sizeof(temp),"%d\r\n",adc_temp); // print to the buffer
	USART_sendString(temp); // send the temp out
}

void USART_init( void )
{
```

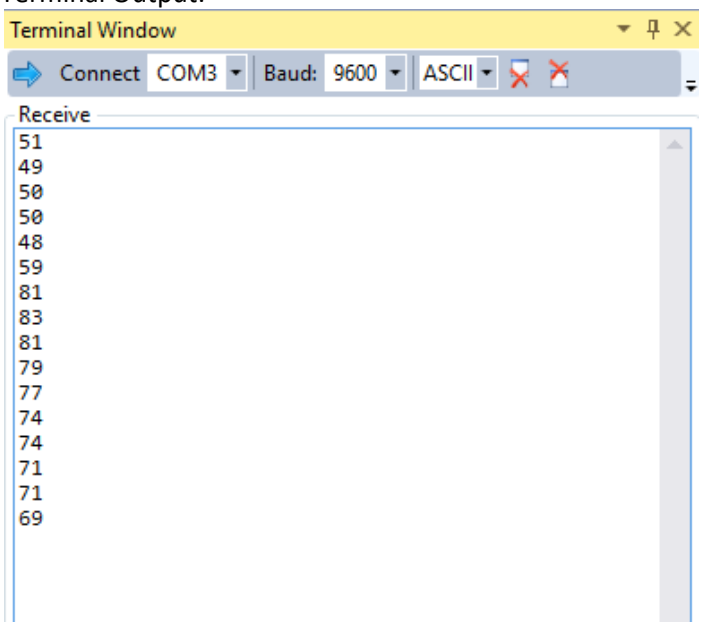
```
	UBRR0H = 0; // not needed
	UBRR0L = BAUD_PRESCALAR; // Baud Prescaler
	UCSR0C = _BV(UCSZ01) | _BV(UCSZ00); /* 8-bit data */
	UCSR0B = _BV(RXEN0) | _BV(TXEN0); /* Enable RX and TX */
}

void USART_sendChar(char ch) {
	while (!(UCSR0A & (1<<UDRE0))); // while data reg is not empty: hold
	UDR0 = ch; // place character into reg
}

void USART_sendString(char* str) {
	while ((*str != '\0')) { // while not the end of the string
		while (!(UCSR0A & (1<<UDRE0))); // while data reg is not empty: hold
		USART_sendChar(*str); //take in character to reg
		str++; // next character
	}
}

void TIMER_init(void) {
	TCNT1 = ONESEC; // ONESEC is the number to count up to 0xFFFF for 1 sec delay
	TIMSK1 |= (1 << TOIE0); // Enable Interrupt for Timer1
	sei(); // Enable Global Interrupt
	TCCR1B |= (1<<CS12)|(1<<CS10); // Start timer 1 and set prescaler to 1024
}

void ADC_init(void) {
	ADMUX |= (0<<REFS1)| // Reference Select
			(1<<REFS0)| // Selected AVcc
			(0<<ADLAR)| // Left Adjust Result OFF
			(1<<MUX2) | // Analog Channel Select
			(0<<MUX1) | // 1 0 1
			(1<<MUX0) ; // Channel 5 or PC5
	ADCSRA |= (1<<ADEN)| // Enable ADC
			(0<<ADSC)| // Do not start conversion
			(0<<ADATE)|// Auto Trigger Disabled
			(0<<ADIF)| // Interrupt Flag Cleared
			(0<<ADIE)| // Interrupt Disabled
			(1<<ADPS2)| // ADC Prescaler Select
			(0<<ADPS1)| // Set to
			(1<<ADPS0); // 32
}
```

4. SCHEMATICS

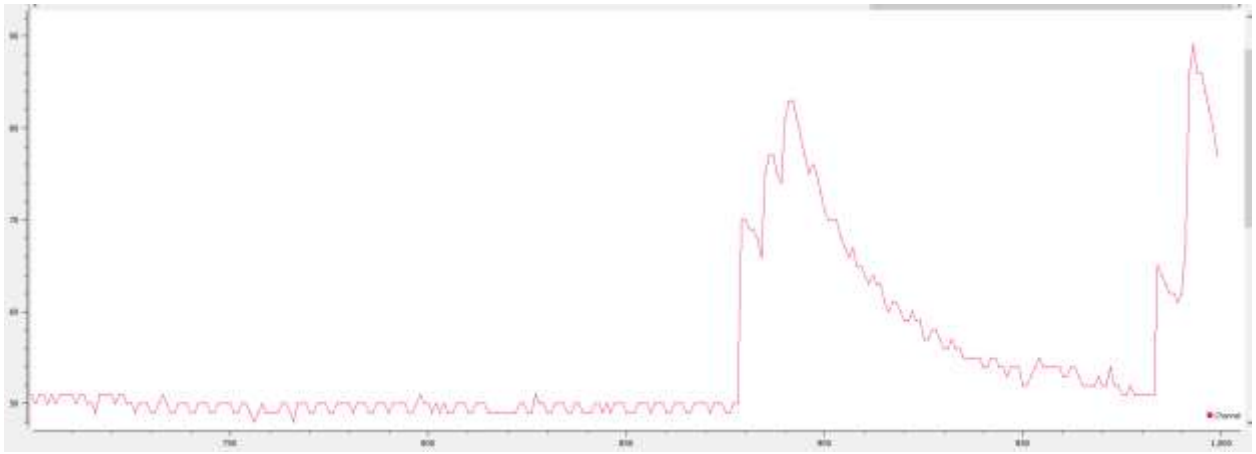


5. SCREENSHOTS OF EACH TASK OUTPUT (ATMEL STUDIO OUTPUT)

Terminal Output:

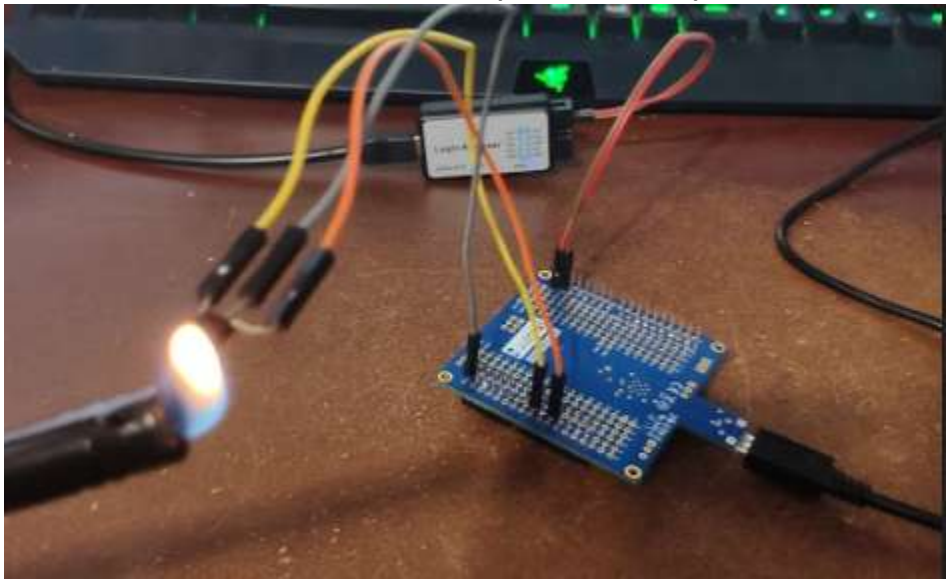


Serial Plot:



Logic Analyzer:

6. SCREENSHOT OF EACH DEMO (BOARD SETUP)



7. VIDEO LINKS OF EACH DEMO

https://youtu.be/9m0bMNAhUso

8. GITHUB LINK OF THIS DA

https://github.com/recrio/submissions/tree/master/DesignAssignments/DA3B

Student Academic Misconduct Policy
http://studentconduct.unlv.edu/misconduct/policy.html

"*This assignment submission is my own, original work*".
Ron Joshua Recrio