CPE301 – SPRING 2019

Design Assignment 5

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Submit the following for all Labs:

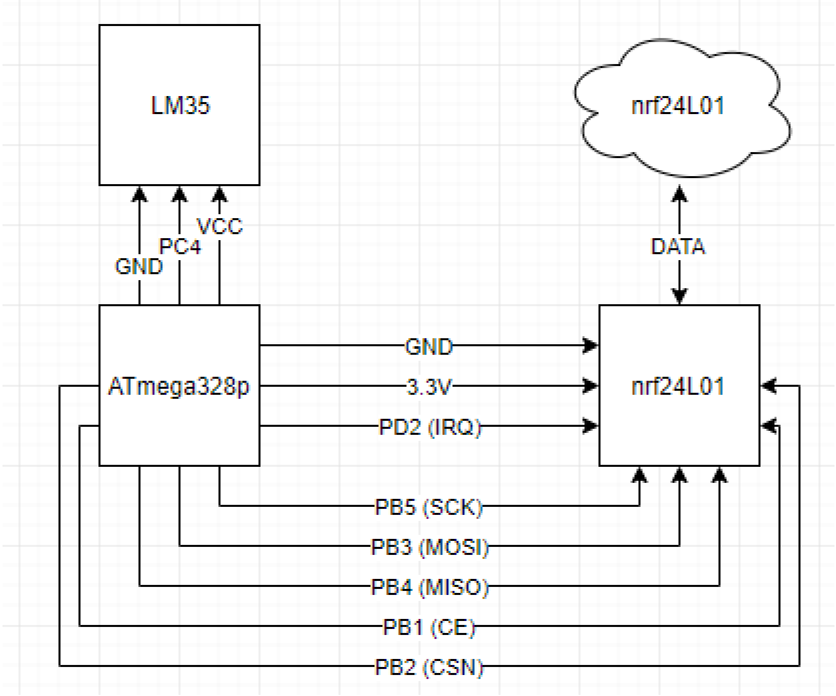
1. In the document, for each task submit the modified or included code (only) with highlights and justifications of the modifications. Also, include the comments.
2. Use the previously create a Github repository with a random name (no CPE/301, Lastname, Firstname). Place all labs under the root folder 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:

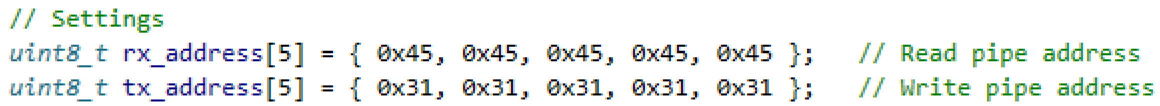
- ATmega328p Xplained Mini
- NRF24L01
- LM35

Block diagram with pins used in the Atmega328P



2. INITIAL CODE OF TASK 1/B

settings changed in lib file



```
// Settings
uint8_t rx_address[5] = { 0x45, 0x45, 0x45, 0x45, 0x45 };   // Read pipe address
uint8_t tx_address[5] = { 0x31, 0x31, 0x31, 0x31, 0x31 };   // Write pipe address
```

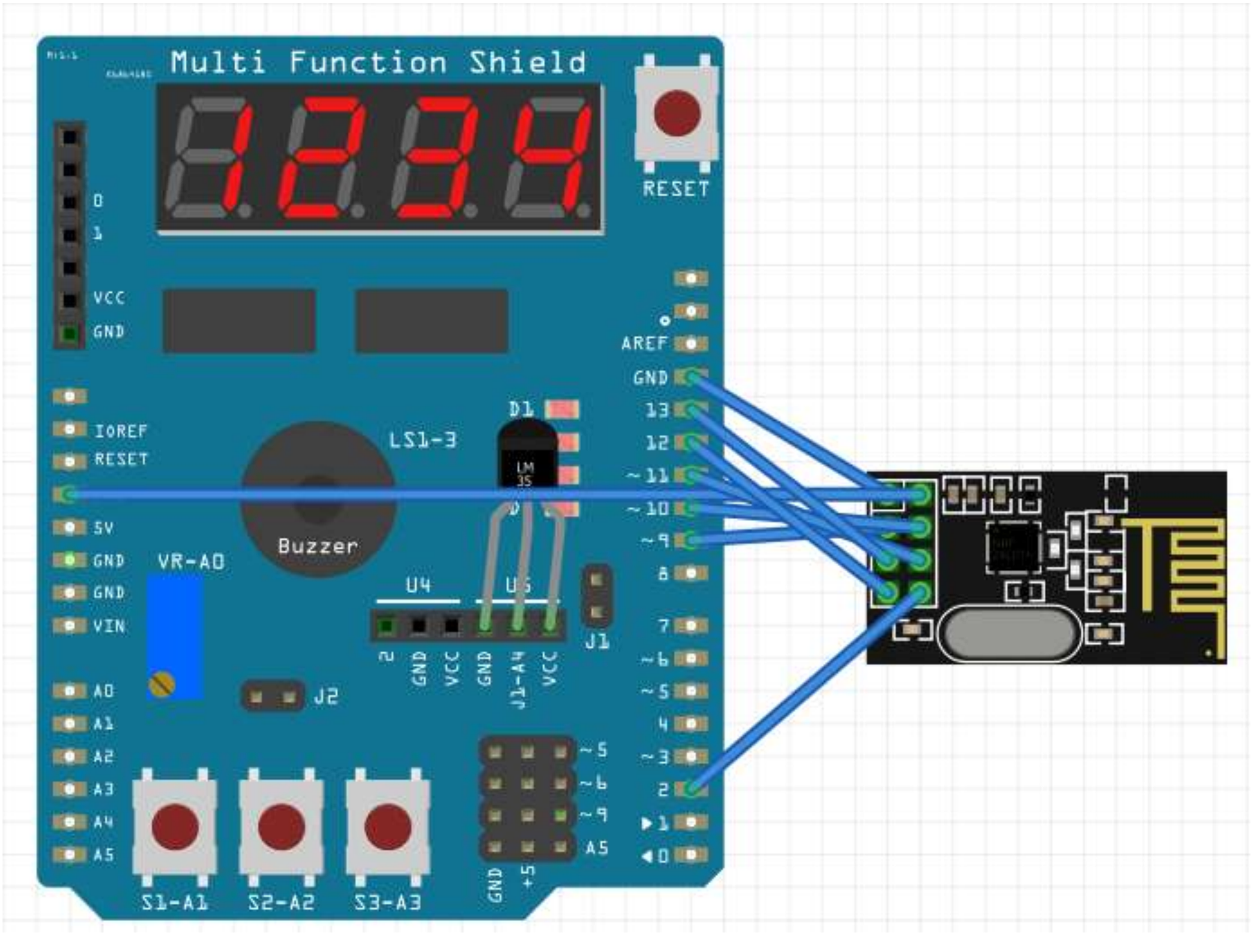
main.c

```
//      Set clock frequency
#ifndef F_CPU
#define F_CPU 16000000UL
#endif

#include <avr/io.h>
#include <util/delay.h>
#include <avr/interrupt.h>
#include <stdbool.h>
#include <stdio.h>
#include <string.h>

//      Set up UART for printf();
#ifndef BAUD
#define BAUD 9600
#endif
#include "inc\STDIO_UART.c"

//      Include nRF24L01+ library
#include "inc\nrf24l01.c"
#include "inc\nrf24l01-mnemonics.h"
#include "inc\spi.c"
void print_config(void);

//      Used in IRQ ISR
volatile bool message_received = false;
volatile bool status = false;

void ADC_init (void);
volatile unsigned adc_temp;
volatile char temp[20];

int main(void)
{
       //      Set cliche message to send (message cannot exceed 32 characters)
       char tx_message[32];                     // Define string array
       strcpy(tx_message,"It's working!");      // Copy string into array

       //      Initialize UART
       uart_init();

       //   Initialize ADC
       ADC_init();

       //      Initialize nRF24L01+ and print configuration info
       nrf24_init();
       print_config();

       //      Start listening to incoming messages
```

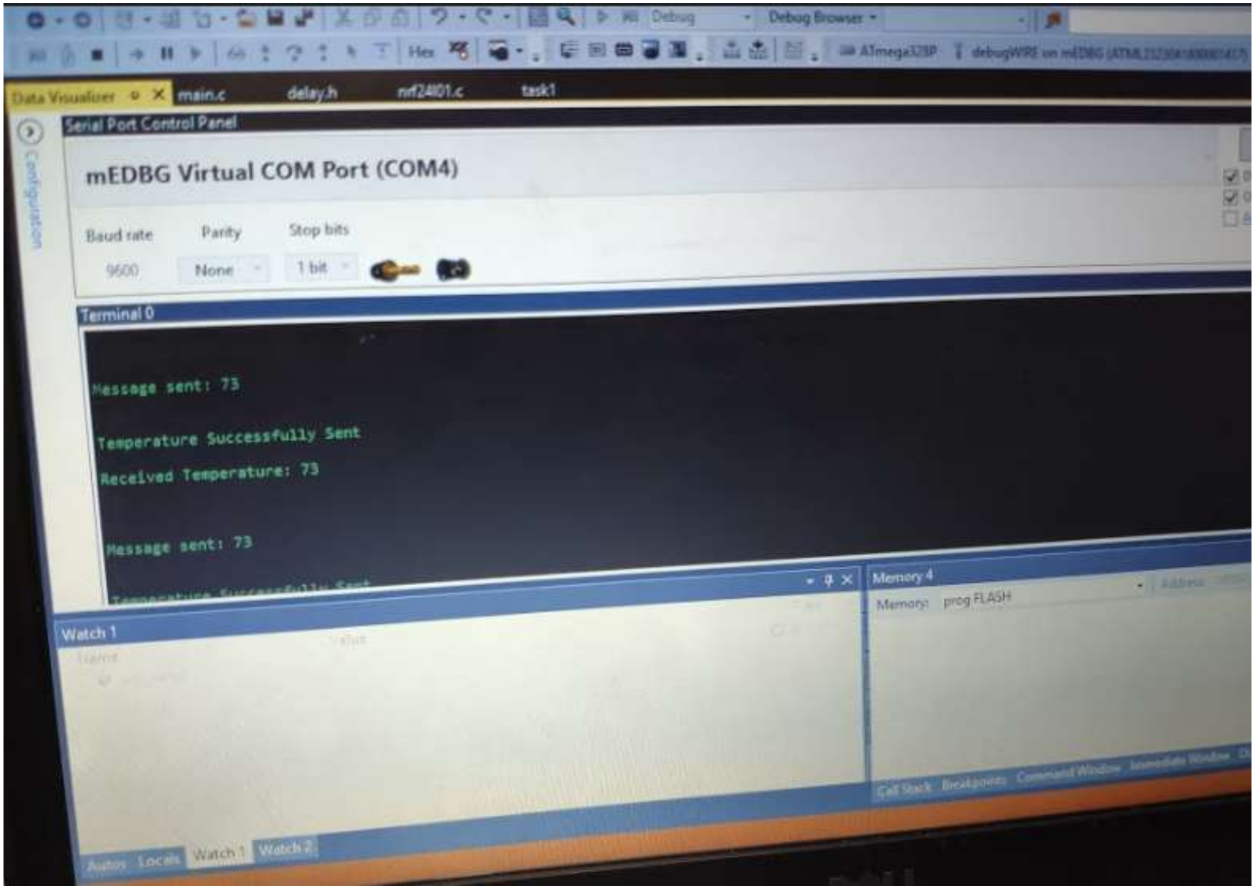
```
        nrf24_start_listening();

        strcpy(tx_message,"Initializing Chat Room..."); // Copy string into array
        nrf24_send_message(tx_message);

        while (1)
        {
                if (message_received)
                {
                        //      Message received, print it
                        message_received = false;
                        printf("Received Temperature: %s\n\n",nrf24_read_message());
                        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
                        adc_temp = (adc_temp/1024.0) * 5000/10;
                        adc_temp = adc_temp*1.8 + 32;
                        snprintf(temp,sizeof(temp),"%d\r\n",adc_temp); // print to the
buffer

                        //      Send message as response
                        _delay_ms(500);
                        status = nrf24_send_message(temp);
                        if (status == true) printf("Temperature Successfully Sent\n\n");
                }
        }
}

//      Interrupt on IRQ pin
ISR(INT0_vect)
{
        message_received = true;
}


//  Prints configuration
void print_config(void)
{
        uint8_t data;
        printf("Startup successful\n\n nRF24L01+ configured as:\n");
        printf("------------------------------------------\n");
        nrf24_read(CONFIG,&data,1);
        printf("CONFIG              0x%x\n",data);
        nrf24_read(EN_AA,&data,1);
        printf("EN_AA               0x%x\n",data);
        nrf24_read(EN_RXADDR,&data,1);
        printf("EN_RXADDR           0x%x\n",data);
        nrf24_read(SETUP_RETR,&data,1);
        printf("SETUP_RETR          0x%x\n",data);
        nrf24_read(RF_CH,&data,1);
        printf("RF_CH               0x%x\n",data);
        nrf24_read(RF_SETUP,&data,1);
        printf("RF_SETUP            0x%x\n",data);
        nrf24_read(STATUS,&data,1);
        printf("STATUS              0x%x\n",data);
```

```
       nrf24_read(FEATURE,&data,1);
       printf("FEATURE             0x%x\n",data);
       printf("-------------------------------------------\n\n");
}

void ADC_init(void) {
       ADMUX  |= (1<<REFS0)| // Selected AVcc
                     (1<<MUX2) ;
       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
}
```

3. SCHEMATICS



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



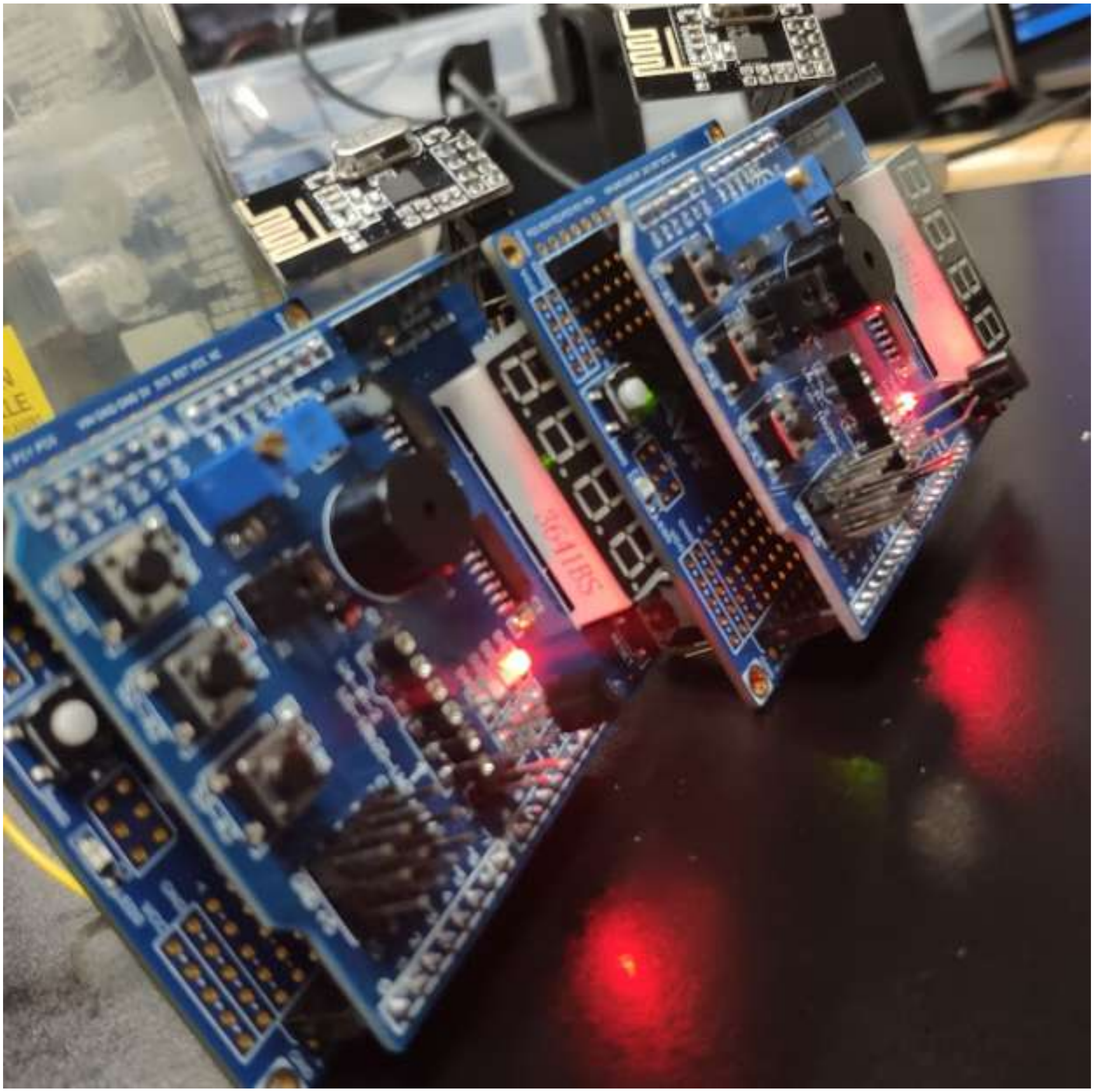
mEDBG Virtual COM Port (COM4)

Baud rate: 9600
Parity: None
Stop bits: 1 bit

Memory: prog FLASH

```
Message sent: 73

Temperature Successfully Sent
Received Temperature: 73


Message sent: 73

Temperature Successfully Sent
```

5. SCREENSHOT OF EACH DEMO (BOARD SETUP)



6. VIDEO LINKS OF EACH DEMO

https://youtu.be/ZMXrQmhXJXM

7. GITHUB LINK OF THIS DA

https://github.com/recrio/submissions/tree/master/DesignAssignments/DA5

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

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