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CPE301 – SPRING 2018

Mid-Term 2

DO NOT REMOVE THIS PAGE DURING SUBMISSION:

The student understands that all required components should be submitted in complete for grading of this assignment.

NO	SUBMISSION ITEM	COMPLETED (Y/N)	MARKS (/MAX)
1	COMPONENTS LIST		
2.	C CODE OF TRANSMITTER		
3.	C CODE OF RECEIVER		
4.	BREADBOARD AND SCHEMATIC FOR TRANSMITTER		
5.	BREADBOARD AND SCHEMATIC FOR RECEIVER		
6.	PARTICIPANTS		

1. COMPONENTS LIST

List of Components used:

A) LM34
B) NRF24L01
C) FTDI BASIC
D) ATMEGA328

2. C CODE OF TRANSMITTER

```
#define F_CPU 16000000UL          // CPU Speed for delay
#define FOSC 16000000             // Clock speed
#define BAUD 115200               // Desire baud rate
#define MYUBRR FOSC/8/BAUD-1      // Formula to set the baud rate [Double Transmission
Rate]

#include <avr/io.h>
#include <avr/interrupt.h>
#include <stdlib.h>
#include <stdint.h>
#include <stdbool.h>
#include <string.h>
#include "nrf24l01-mnemonics.h"
#include "nrf24l01.h"

void setup_timer(void);
void UART_TX(char *data);
nRF24L01 *setup_rf(void);

volatile bool rf_interrupt = false;
volatile bool send_message = false;
volatile char ADCvalue;

int main(void)
{
	// Variables
	uint8_t i = 0;             // Iterative variable
	char temp[5];              // Temperature string buffer
	char LF = '\n';            // Line feed
	DDRC = (1 << 5);

	// NRF Settings
	uint8_t to_address[5] = {0x02, 0x04, 0x06, 0x08, 0x0A};// Device address
	sei();                     // Global interrupt enabled
	nRF24L01 *rf = setup_rf(); // Initialize the NRF
	setup_timer();

	// ADC Settings
	ADMUX = 0;                 // Use ADC0
	ADMUX |= (1 << REFS0);     // AVcc is reference with ARef connected to external
capacitor
	ADCSRA |= (1 << ADPS2) | (1 << ADPS1) | (1 << ADPS0);// 16 MHz with prescalar of
128
```

```
	ADCSRA |= (1 << ADATE);                  // Enable auto trigger
	ADCSRB = 0;                              // Free running settings for auto trigger
	ADCSRA |= (1 << ADEN);                   // Enable ADC
	ADCSRA |= (1 << ADSC);                   // Start conversion

	// UART Settings
	UBRR0H = ((MYUBRR) >> 8);                // Set baud rate for UPPER Register
	UBRR0L = MYUBRR;                         // Set baud rate for LOWER Register
	UCSR0A |= (1 << U2X0);                   // Double UART transmission speed
	UCSR0B |= (1 << TXEN0);                  // Enable transmitter
	UCSR0C |= (1 << UCSZ01) | (1 << UCSZ00); // Frame: 8-bit Data and 1 Stop bit

	while (1)
	{
		// ADC Conversion
		while((ADCSRA & (1 << ADIF)) == 0);      // Wait for ADC conversion
		ADCvalue = (ADC >> 1);                   // Assign the temperature

		// Check if the message has been successfully transmitted
		if(rf_interrupt)
		{
			rf_interrupt = false;
			int success = nRF24L01_transmit_success(rf);
			if(success != 0)
			nRF24L01_flush_transmit_message(rf);
		}

		if(send_message)
		{
			send_message = false;       // Reset message flag
			nRF24L01Message msg;        // Message structure to be transmitted
			i = 0;                      // Reset iterative variable
			itoa(ADCvalue, temp, 10);   // Convert integer value into ASCII

			// Transmit the temperature to terminal [NULL terminated]
			while(temp[i] != 0)
			{
				UART_TX(&temp[i]);   // Sends temperature to terminal
				i++;                 // Size of the temperature string
			}
			UART_TX(&LF);               // Line feed

			// NRF Transmission
			msg.length = i + 1;// Save the length of the temperature string
			memcpy(msg.data, temp, msg.length);// Copy the string into the
struct
			nRF24L01_transmit(rf, to_address, &msg);// Transmit the temperature
		}
	}
	return 0;
}

nRF24L01 *setup_rf(void)
{
	nRF24L01 *rf = nRF24L01_init();
	rf->ss.port = &PORTB;
	rf->ss.pin = PB2;
	rf->ce.port = &PORTB;
```

```
	rf->ce.pin = PB1;
	rf->sck.port = &PORTB;
	rf->sck.pin = PB5;
	rf->mosi.port = &PORTB;
	rf->mosi.pin = PB3;
	rf->miso.port = &PORTB;
	rf->miso.pin = PB4;
	EICRA |= _BV(ISC01);
	EIMSK |= _BV(INT0);
	nRF24L01_begin(rf);
	return rf;
}

void setup_timer(void)
{
	TCCR1B |= _BV(WGM12);			// CTC Mode
	TIMSK1 |= _BV(OCIE1A);			// COMP Interrupt
	OCR1A = 15624;				// 16 MHz/1024
	TCCR1B |= _BV(CS10) | _BV(CS12);	// Prescalar 1024
}

// UART transmission function
void UART_TX(char *data)
{
	while(!(UCSR0A & (1 << UDRE0)));	// Wait for UART to be available
	UDR0 = *data;				// Send the data
}

ISR(TIMER1_COMPA_vect)
{
	send_message = true;
	PORTC ^= (1 << 5);
}

ISR(INT0_vect)
{
	rf_interrupt = true;
}
```

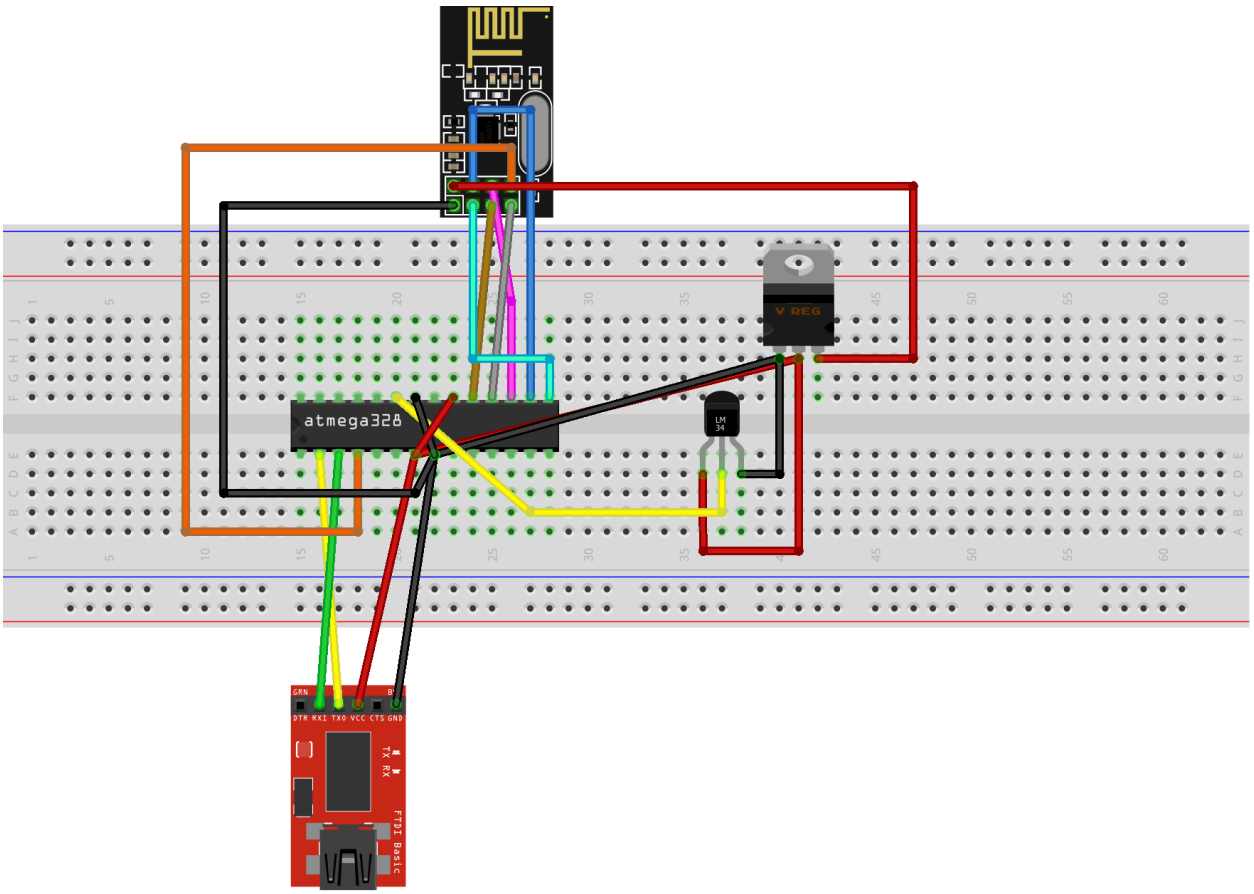
3. C CODE OF RECEIVER

```
#define F_CPU 16000000UL		// CPU Speed for delay
#define FOSC 16000000			// Clock speed
#define BAUD 115200			// Desire baud rate
#define MYUBRR FOSC/8/BAUD-1		// Formula to set the baud rate [Double Transmission]

#include <avr/io.h>
#include <avr/interrupt.h>
#include <stdlib.h>
#include <stdint.h>
#include <stdbool.h>
#include <string.h>
#include "nrf24l01-mnemonics.h"
#include "nrf24l01.h"

nRF24L01 *setup_rf(void);
void process_message(char *message, uint8_t len);
```

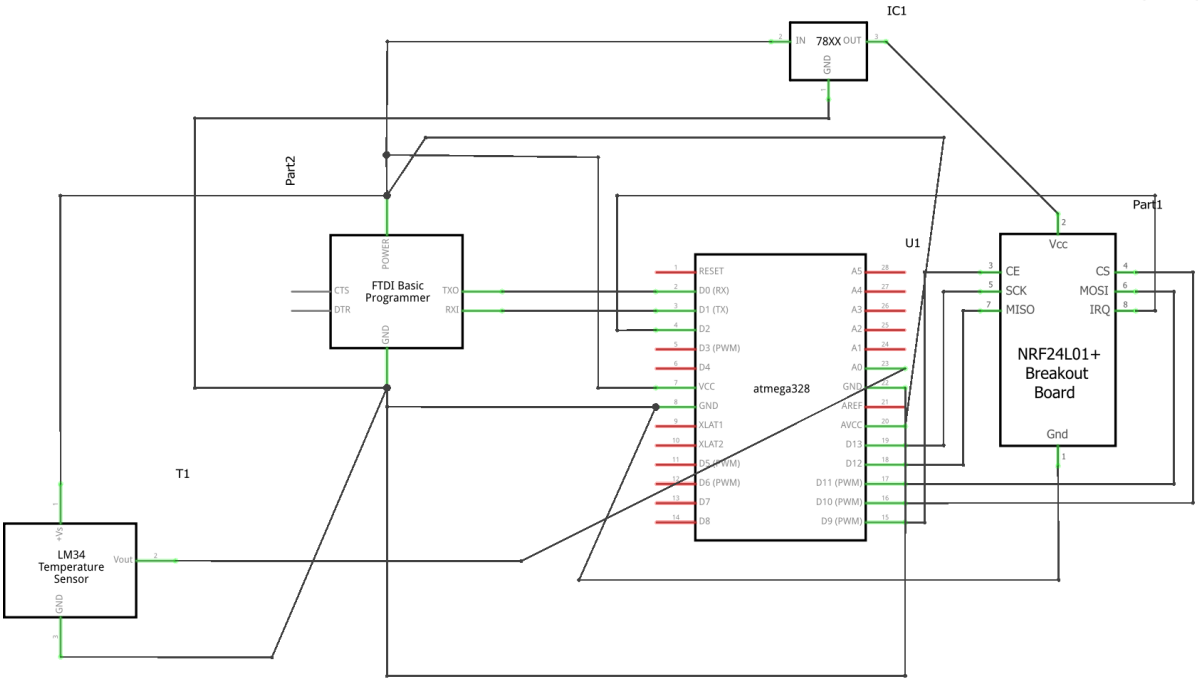
```
void UART_TX(char *data);

volatile bool rf_interrupt = false;

int main(void)
{
	// NRF Settings
	uint8_t address[5] = {0x02, 0x04, 0x06, 0x08, 0x0A};
	//prepare_led_pin();
	sei();
	nRF24L01 *rf = setup_rf();
	nRF24L01_listen(rf, 0, address);
	uint8_t addr[5];
	nRF24L01_read_register(rf, CONFIG, addr, 1);

	// USART Settings
	UBRR0H = ((MYUBRR) >> 8);          // Set baud rate for UPPER Register
	UBRR0L = MYUBRR;                   // Set baud rate for LOWER Register
	UCSR0A |= (1 << U2X0);             // Double UART transmission speed
	UCSR0B |= (1 << TXEN0);            // Enable transmitter
	UCSR0C |= (1 << UCSZ01) | (1 << UCSZ00); // Frame: 8-bit Data and 1 Stop bit

	while (1)
	{
		if(rf_interrupt)
		{
			rf_interrupt = false;
			while(nRF24L01_data_received(rf))
			{
				nRF24L01Message msg;
				nRF24L01_read_received_data(rf, &msg);
				process_message((char *)msg.data, msg.length);
			}
			nRF24L01_listen(rf, 0, address);
		}
	}
	return 0;
}

nRF24L01 *setup_rf(void)
{
	nRF24L01 *rf = nRF24L01_init();
	rf->ss.port = &PORTB;
	rf->ss.pin = PB2;
	rf->ce.port = &PORTB;
	rf->ce.pin = PB1;
	rf->sck.port = &PORTB;
	rf->sck.pin = PB5;
	rf->mosi.port = &PORTB;
	rf->mosi.pin = PB3;
	rf->miso.port = &PORTB;
	rf->miso.pin = PB4;
	EICRA |= _BV(ISC01);
	EIMSK |= _BV(INT0);
	nRF24L01_begin(rf);
	return rf;
}
```

```
void process_message(char *message, uint8_t len)
{
	uint8_t i = 0;			// Iterative variable
	char LF = '\n';			// Line Feed

	// Process the temperature and display to UART
	for(i = 0; i < len; i++)
	{
		UART_TX(&message[i]);
	}
	UART_TX(&LF);
}

ISR(INT0_vect)
{
	rf_interrupt = true;
}

// UART transmission function
void UART_TX(char *data)
{
	while(!(UCSR0A & (1 << UDRE0)));  // Wait for UART to be available
	UDR0 = *data;                     // Send the data
}
```

4. BREADBOARD AND SCHEMATIC OF TRANSMITTER



fritzing



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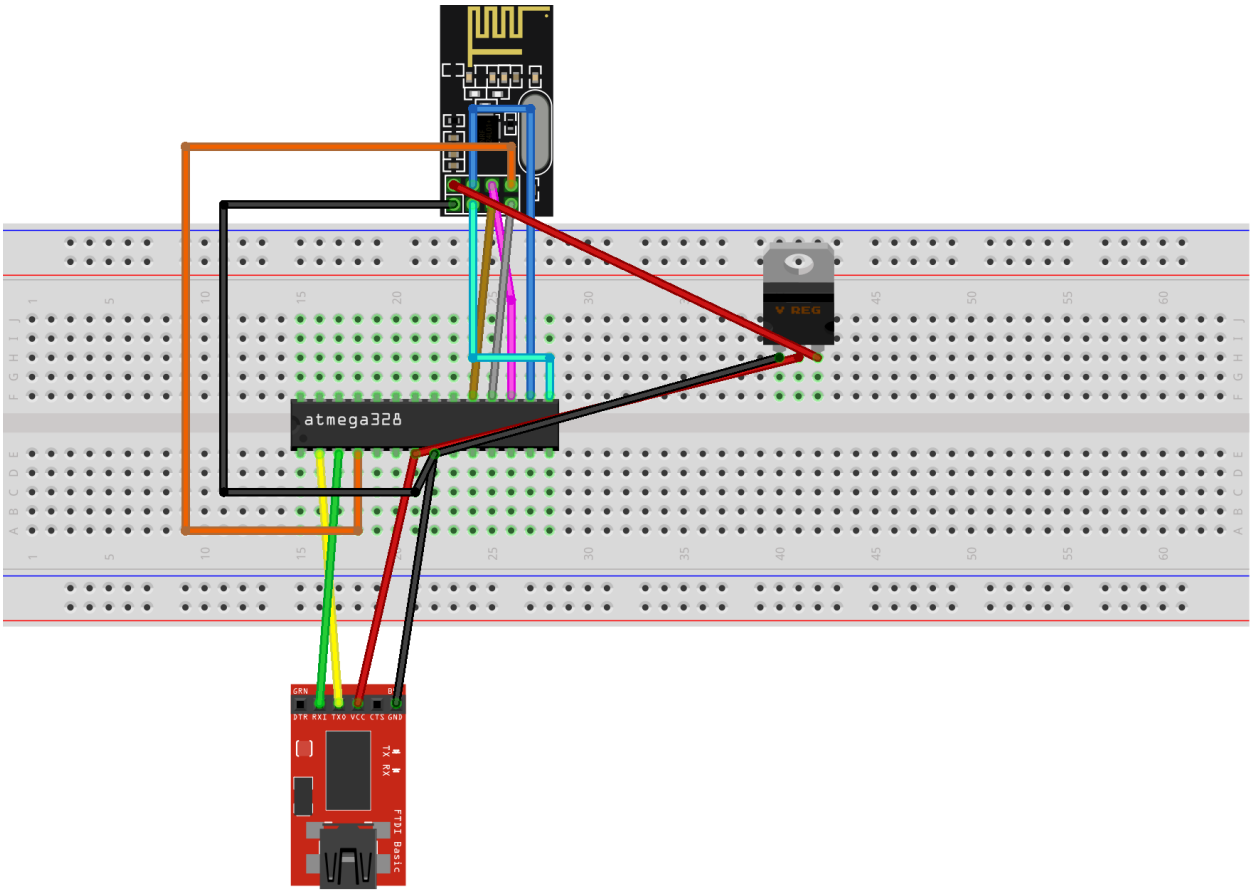
5. BREADBOARD AND SCHEMATIC OF RECEIVER



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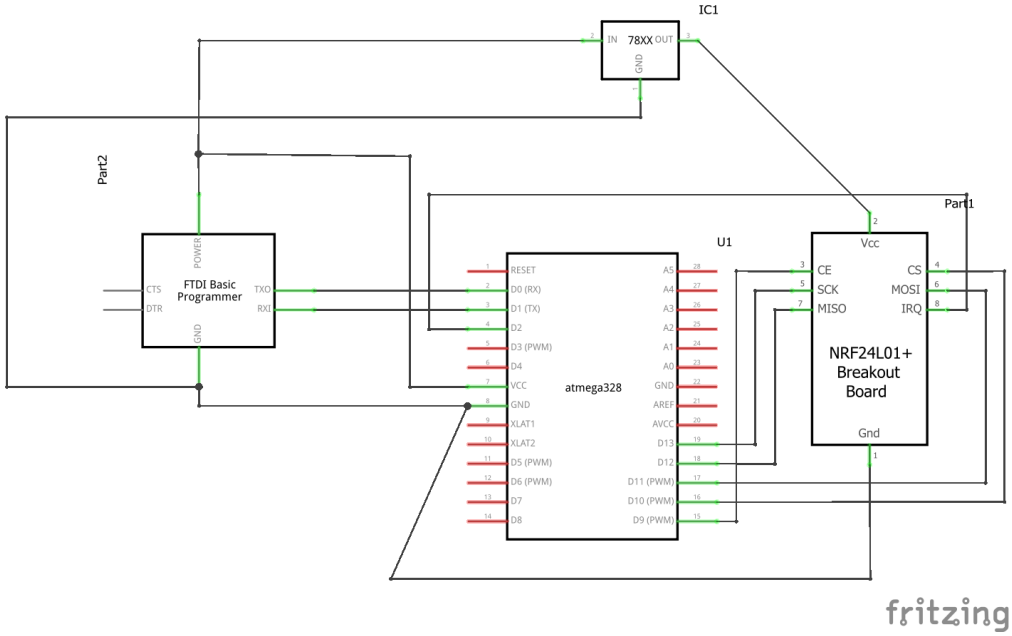

fritzing

6. PARTICIPANTS

Tenniel, Argenis, and Jeffrey

Student Academic Misconduct Policy
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BRYAN TAKEMOTO