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CPE301 – SPRING 2018

Midterm 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 AND CONNECTION BLOCK DIAGRAM w/ PINS		
2.	INITIAL CODE OF TASK 1/A		
3.	INCREMENTAL / DIFFERENTIAL CODE OF TASK 2/B		
3.	INCREMENTAL / DIFFERENTIAL CODE OF TASK 3/C		
3.	INCREMENTAL / DIFFERENTIAL CODE OF TASK 4/D		
3.	INCREMENTAL / DIFFERENTIAL CODE OF TASK 5/E		
4.	SCHEMATICS		
5.	SCREENSHOTS OF EACH TASK OUTPUT		
5.	SCREENSHOT OF EACH DEMO		
6.	VIDEO LINKS OF EACH DEMO		
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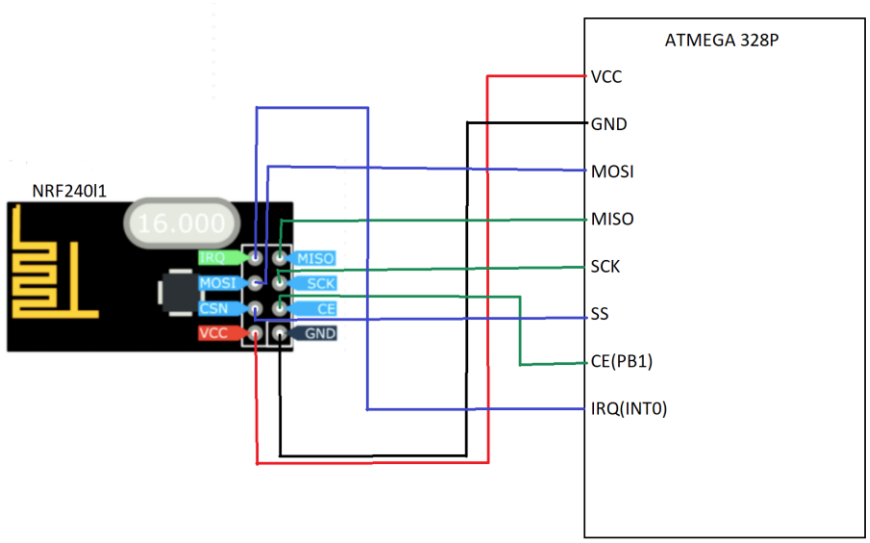
1. COMPONENTS LIST AND CONNECTION BLOCK DIAGRAM w/ PINS

The Components used in this lab we 2 Atmega 328p's and 2 NRF24l01 modules.



2. INITIAL/DEVELOPED CODE OF TASK 1

```
/*
* Midterm2_Transmit.c
*
* Created: 4/12/2018 8:55:33 AM
* Author : trace / guillermo
*/

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

#define F_CPU 1000000UL

#define FOSC 16000000
#define BAUD  9600
#define MYUBRR FOSC/16/BAUD-1


void setup_timer(void);
```

```
nRF24L01 *setup_rf(void);
void initUART();
void ADC_Init();
void writeChar(char *c);
void USART_Init();

volatile bool rf_interrupt = false;
volatile bool send_message = false;
volatile uint8_t adcValue;

char seeTemp[3];
char *seeTemp2;


int main(void) {
    uint8_t to_address[5] = { 0x78, 0x78, 0x78, 0x78, 0x78 };
    bool on = false;



    ADC_Init();
    setup_timer();
    USART_Init();

    nRF24L01 *rf = setup_rf();


    while (true) {
        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;
            on = !on;
            nRF24L01Message msg;
            if (on)
            {
            memcpy(msg.data, seeTemp2, 3);
            }

            msg.length = strlen((char *)msg.data) + 1;
            writeChar(msg.data);
```

```
            nRF24L01_transmit(rf, to_address, &msg);
        }
    }

    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;
    // interrupt on falling edge of INT0 (PD2)
    EICRA |= _BV(ISC01);
    EIMSK |= _BV(INT0);
    nRF24L01_begin(rf);
    return rf;
}

// setup timer to trigger interrupt every second when at 1MHz
void setup_timer(void) {
    TCCR1B |= _BV(WGM12);
    TIMSK1 |= _BV(OCIE1A);
    TIMSK1 |= _BV(TOIE1);
    OCR1A = 15624;
    //OCR1A = 33000;
    TCCR1B |= _BV(CS10) | _BV(CS11);
}

//ADC initialization function
void ADC_Init()
{
// initialize ADC
        DDRC = 0;               // Set PORTC as input for adc
        DIDR0 = 0x1;        // Disable digital input on ADC0 pin
        ADMUX = 0;              // ADC0 (PC.0) used as analog input
        ADMUX |= (1 << REFS0);    // use AVcc as the reference
        ADMUX |= (1 << ADLAR);    // Right adjust for 8 bit resolution
```

```
        ADCSRA = 0x87;          // Enable ADC, system clock, 10000111
        ADCSRB = 0x0;       // Free running mode

        sei();                  //enable global interrupts


}//end ADC_Init

// each one second interrupt
ISR(TIMER1_COMPA_vect) {
    send_message = true;

            char temperature[6];

    TIFR1 |= (1 << TOV1);      //Clr Flag
    //fifteenPlus++;


    float  lm34_0;           //For ASCII Temp output

    ADCSRA |= (1 << ADSC);                          //Start Conversion
    while((ADCSRA & (1 << ADIF)) == 0);              //Wait for conversion to finish

    //Conversion to °F
    lm34_0 = (ADCH * 5.0 / 0x100) * 100.0;     //(ADC * 5 = 200 /256) * 100
    dtostrf(lm34_0, 3, 0, temperature);                    //Float to char conversion
        seeTemp2 = temperature;
}

// nRF24L01 interrupt
ISR(INT0_vect) {
    rf_interrupt = true;

}


void writeChar(char *c) {

int i = 0;
while(i<3){
    UDR0 = c[i];            // Display character on serial (i.e., PuTTY) terminal
    _delay_ms(10);          // delay for 200 ms
    i++;
}

}
```

```
void USART_Init()
{

    /*Set Baud Rate*/
    UBRR0H = (MYUBRR>>8);     //Shift MSB "top" of UBRR0H 0100 0100 >> 8 -> UBRR0H 0000 0000
    UBRR0L = MYUBRR;          //UBRR0L 0100 0100

    UCSR0B |= (1 << RXEN0) | (1 << TXEN0);   //Enable Rec and Trans
    UCSR0B |= (1 << RXCIE0);                 //Enable Rec INT
    UCSR0C |= (1 << UCSZ01) | (1 << UCSZ00); //Set frame 8-bit, 1 STP
}//end USART_int



/*
* Midterm2_Receive.c
*
* Created: 4/15/2018 2:47:49 PM
* Author : trace / guillermo
*/

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

#define F_CPU 1000000UL

#define FOSC 16000000
#define BAUD  9600
#define MYUBRR FOSC/16/BAUD-1


nRF24L01 *setup_rf(void);
void process_message(char *message);
inline void prepare_led_pin(void);
inline void  set_led_high(void);
inline void  set_led_low(void);
void USART_Init();
void writestring(char *c);
void writeChar(unsigned char c);

volatile bool rf_interrupt = false;
```

```
int main(void) {

	USART_Init();	// Initialize UART

	bool on = false;

	uint8_t address[5] = { 0x78, 0x78, 0x78, 0x78, 0x78 };
	prepare_led_pin();
	sei();
	nRF24L01 *rf = setup_rf();
	nRF24L01_listen(rf, 0, address);
	uint8_t addr[5];
	nRF24L01_read_register(rf, CONFIG, addr, 1);

	while (true) {
		if (rf_interrupt) {
			rf_interrupt = false;
			while (nRF24L01_data_received(rf)) {
				nRF24L01Message msg;
				nRF24L01_read_received_data(rf, &msg);
				process_message((char *)msg.data);
				if(true){
				writestring("Temperature: ");
				writestring(msg.data);
				writestring("F");
				writestring("\r");

				}
			}

			nRF24L01_listen(rf, 0, address);
		}
	}

	return 0;
}

void USART_Init()
{

	/*Set Baud Rate*/
	UBRR0H = (MYUBRR>>8);	//Shift MSB "top" of UBRR0H 0100 0100 >> 8 -> UBRR0H 0000 0000
	UBRR0L = MYUBRR;		//UBRR0L 0100 0100

	UCSR0B |= (1 << RXEN0) | (1 << TXEN0);	//Enable Rec and Trans
	UCSR0B |= (1 << RXCIE0);			//Enable Rec INT
	UCSR0C |= (1 << UCSZ01) | (1 << UCSZ00); //Set frame 8-bit, 1 STP
}//end USART_int
```

```
void writeChar(unsigned char c) {
	UDR0 = c;		// Display character on serial (i.e., PuTTY) terminal
	_delay_ms(400);		// delay for 200 ms
}

void writestring(char *c){
	unsigned int i = 0;
	while(c[i] != 0)
	writeChar(c[i++]);
}


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;
	// interrupt on falling edge of INT0 (PD2)
	EICRA |= _BV(ISC01);
	EIMSK |= _BV(INT0);
	nRF24L01_begin(rf);
	return rf;
}

void process_message(char *message) {

	if (strcmp(message, "ON") == 0)
	set_led_high();
	else if (strcmp(message, "OFF") == 0)
	set_led_low();

}

inline void prepare_led_pin(void) {
	DDRB |= _BV(PB0);
	PORTB &= ~_BV(PB0);
}

inline void set_led_high(void) {
	PORTB |= _BV(PB0);
```

```
}

inline void set_led_low(void) {
        PORTB &= _BV(PB0);
}

// nRF24L01 interrupt
ISR(INT0_vect) {
        rf_interrupt = true;
}
```

3. SCHEMATICS

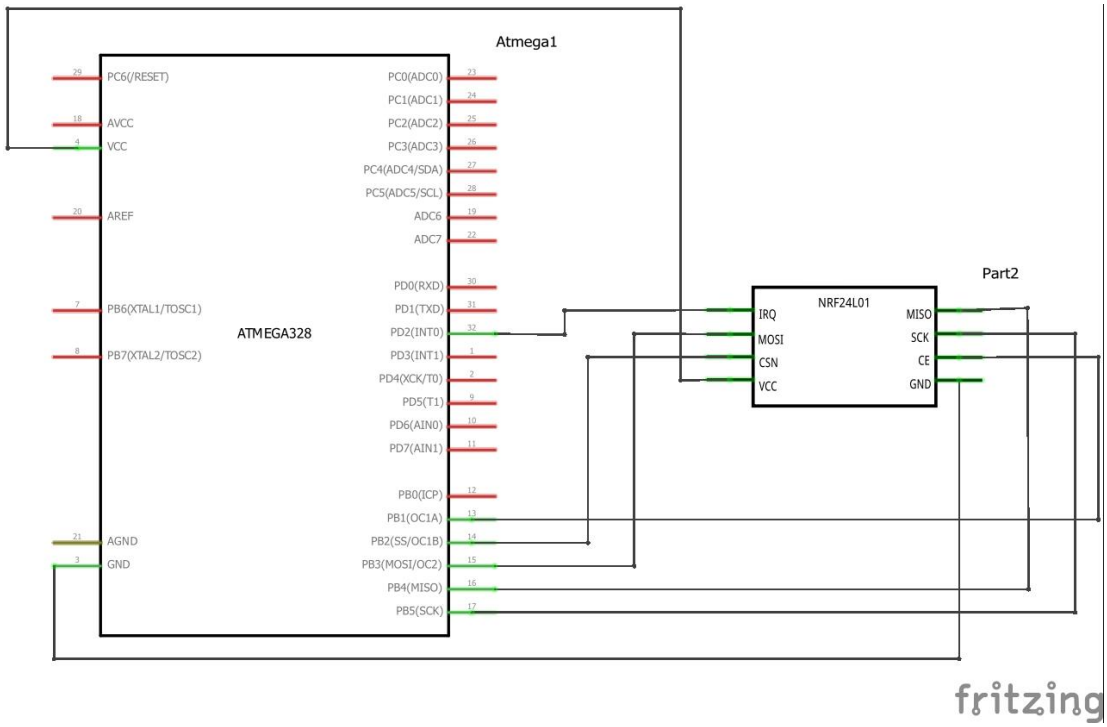


Figure 1: Receiver Schematic

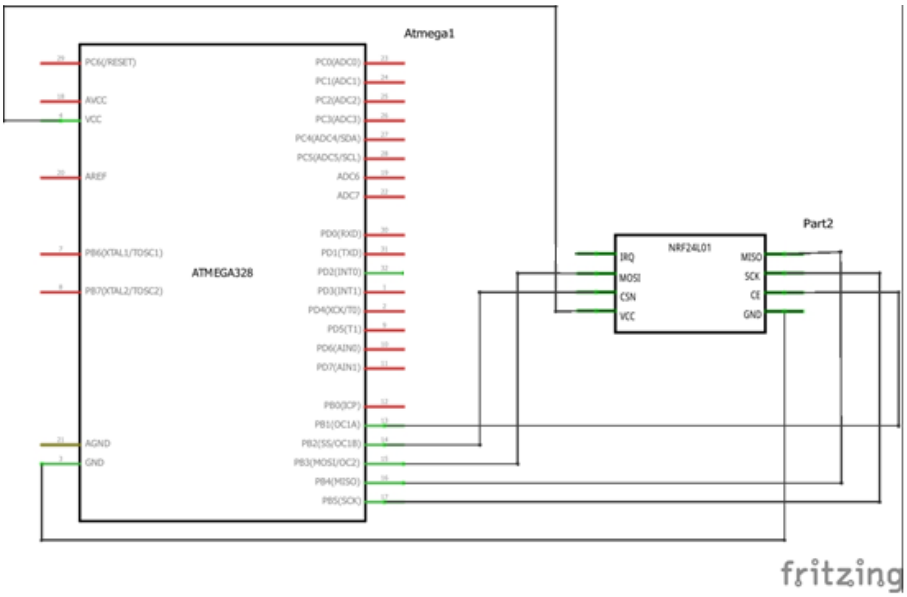


Figure 2: Sender Schematic

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

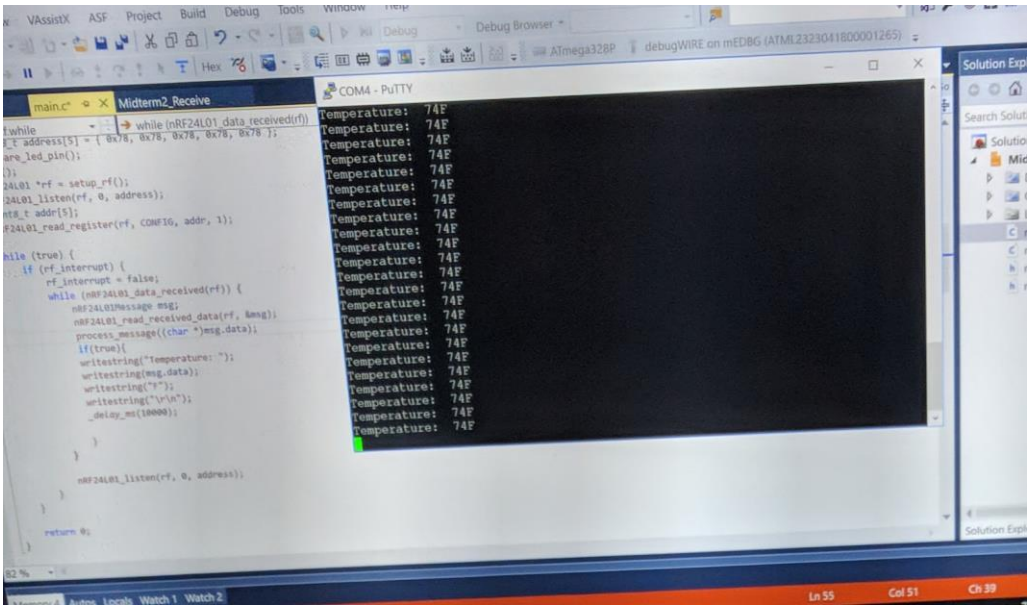


Figure 3: Putty output from Receiver

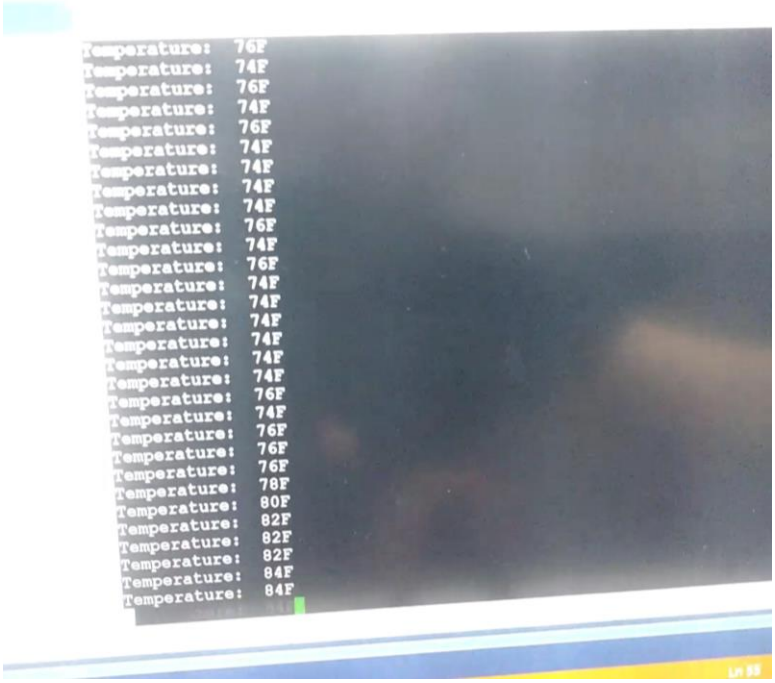


Figure 4: Putty output from receiver

5. SCREENSHOT OF EACH DEMO (BOARD SETUP)

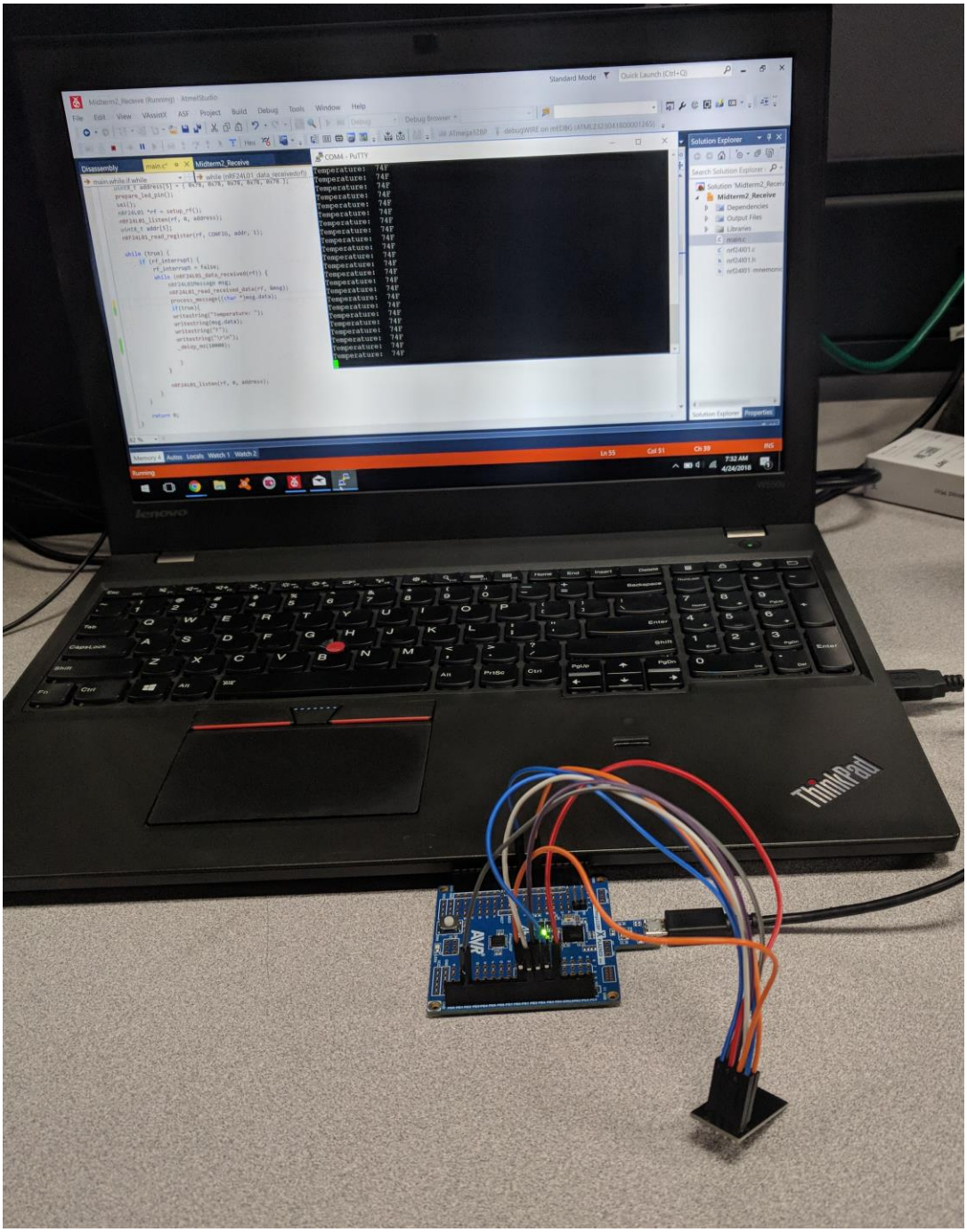


Figure 5: Receiver

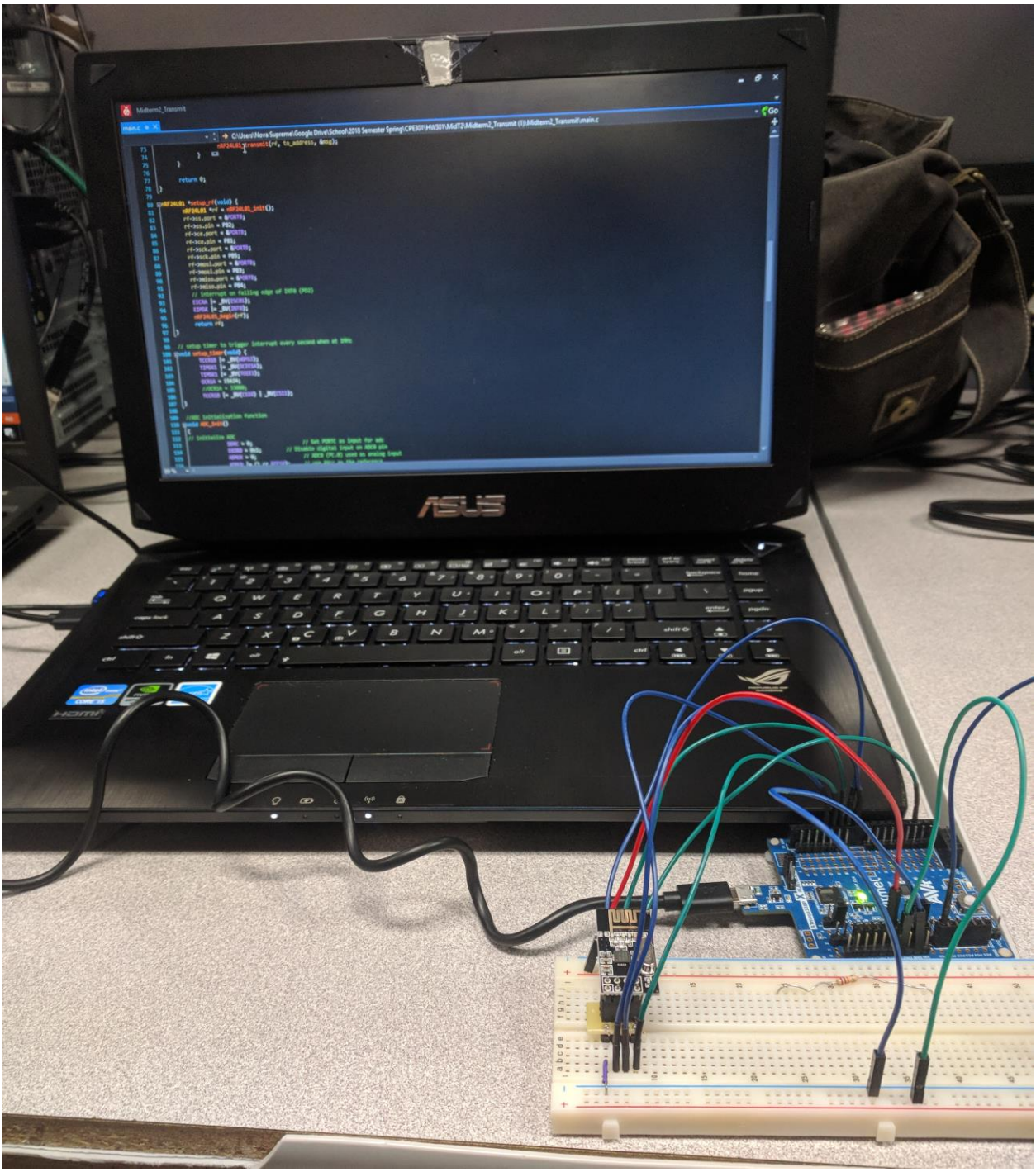


Figure 6: Sender

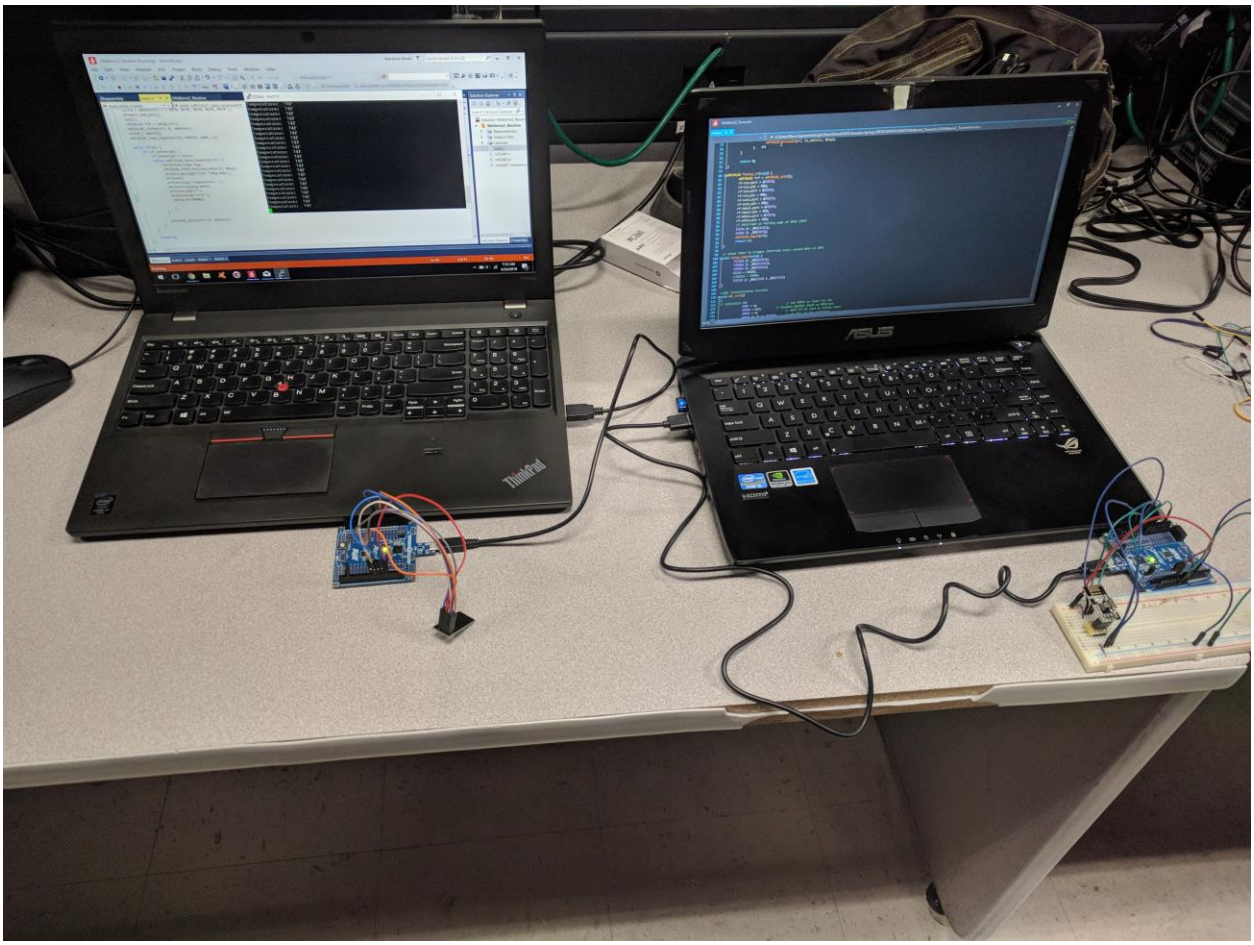


Figure 7: Sender and Receiver

6. VIDEO LINKS OF EACH DEMO

https://www.youtube.com/watch?v=PoDQDhIuC0Q – Trace Stewart Video

7. GITHUB LINK OF THIS DA

https://github.com/TraceStewart/epc103gnirps8102vlnu/tree/master/Midterm_2

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"*This assignment submission is my own, original work*".
Trace Stewart
Guillermo Galvez