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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		
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1. COMPONENTS LIST AND CONNECTION BLOCK DIAGRAM w/ PINS

- 2 ATmegas 328p Microcontrollers
- NRF24L01 Transceiver
- LM34 Temperature Sensor

## 2.	INITIAL/DEVELOPED CODE OF TASK 1/A

(TRANSMIT CODE)

```
#include <avr/io.h>
#include <avr/interrupt.h>
#include <stdbool.h>
#include <string.h>
#include "nrf24l01.h"
#include "ioe.h"

void setup_timer(void);
nRF24L01 *setup_rf(void);
void adc_init(void);

volatile bool rf_interrupt = false;
volatile bool send_message = false;
volatile int temp;
vchar outs[3];

int main(void) {
       usart0_init_();
       uint8_t to_address[5] = { 0x11, 0x11, 0x11, 0x11, 0x11 };
       bool on = false;
       DDRC = 0x00;
       sei();
       nRF24L01 *rf = setup_rf();
       setup_timer();

       while (true) {
              while(ADCSRA & (1<<ADSC));
              temp = ADC;
              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;
                     sprintf(outs, "%d" ,  temp);
                     memcpy(msg.data, outs, 3);
                     msg.length = strlen((char *)msg.data) + 1;
                     nRF24L01_transmit(rf, to_address, &msg);
              }
       }

       return 0;
}

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

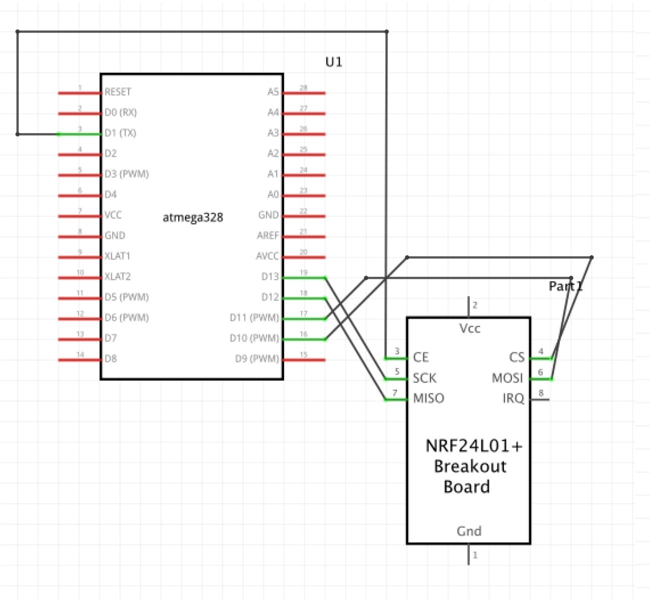
```
        rf->ss.pin = PB2;
        rf->ce.port = &PORTB;
        rf->ce.pin = PB1;
        rf->sck.port = &PORTB;
        rf->sck.pin = PB5;
        rf->mosi.port = &PORTB;
        rf->mosi.pin = PB3;
        rf->miso.port = &PORTB;
        rf->miso.pin = PB4;
        // interrupt on falling edge 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);
        OCR1A = 15624;
        TCCR1B |= _BV(CS10) | _BV(CS11);
}

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

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

void adc_init()
{
        ADMUX =0;
        ADCSRA= (1<<ADPS0) | (1<<ADPS1) | (1<<ADPS2);   //sample rate of 125kHz at 16MHz
        ADMUX |= (1<<REFS0);                                          //Set ADC reference
to AVCC
        ADMUX |= (1<<ADLAR);                                          //Left adjust ADC
Result to allow 8 bit reading

        ADCSRA |= (1<<ADEN);                                          //Enable ADC
        ADCSRA |= (1<<ADATE);                                                //set ADC
auto trigger enable
        ADCSRB = 0;                                                                 //0
for free running mode
        ADCSRA |= (1<<ADSC)  ;                                               //start A2D
Conversion

}
```

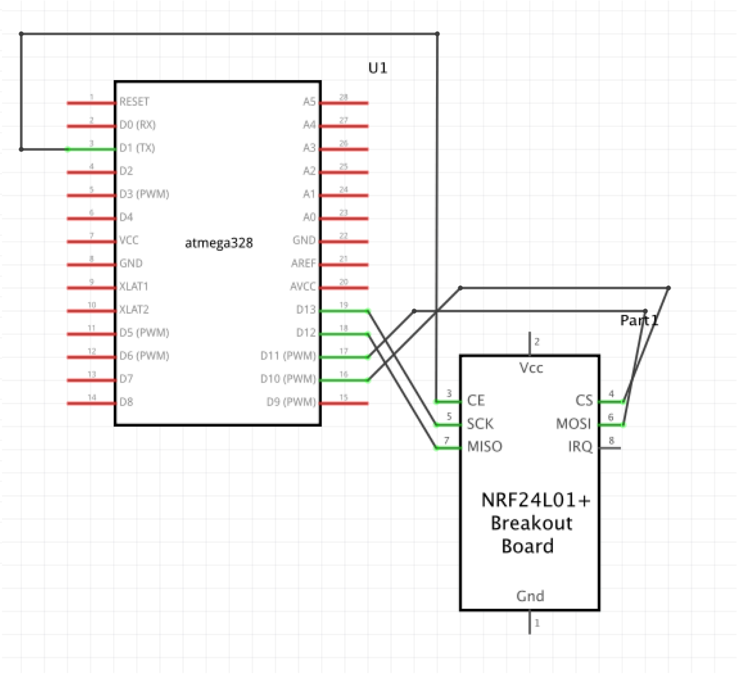
(RECEIVER CODE)

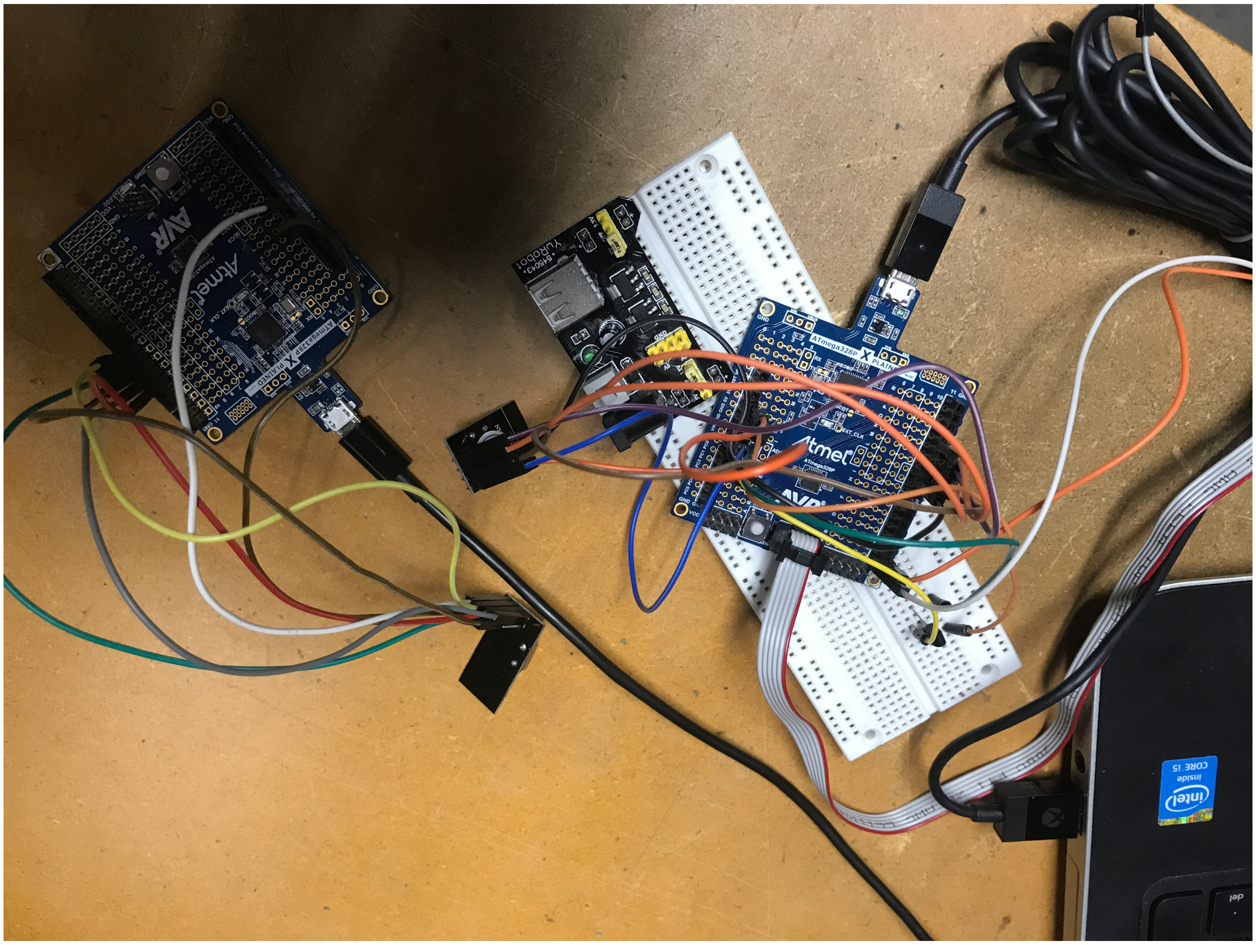
```
#include <avr/io.h>
#include <avr/interrupt.h>
#include <stdbool.h>
#include <string.h>
#ifndef F_CPU
#define F_CPU 16000000UL
#endif
#include <util/delay.h>
#include "nrf24l01.h"
#include "ioe.h"
#include "nrf24l01-mnemonics.h"


#define UBRR_2400 207

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(unsigned int ubrr);
void USART_tx_string(char* data);

volatile bool rf_interrupt = false;
char* outs[20];

int main(void) {
        usart0_init_();
        _delay_ms(2000);

        uint8_t address[5] = { 0x11, 0x11, 0x11, 0x11, 0x11 };
        printm("Address INIT\r\n");
        prepare_led_pin();
        printm("LED PREP\r\n");

        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);
                        }

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

void process_message(char *message) {
       printm(message);
}

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;
}

void USART_INIT(unsigned int ubrr){
       UBRR0H = (unsigned char)(ubrr>>8);
       UBRR0L = (unsigned char)ubrr;
       UCSR0B = (1<<TXEN0);

       UCSR0C = (1<<UCSZ00);
}

void USART_tx_string(char* data){
       while((*data != '\0')){
              while(!(UCSR0A & (1<<UDRE0)));
              UDR0 = *data;
              data++;
       }
}
```

3. SCHEMATICS







4. VIDEO LINKS OF EACH DEMO

https://youtu.be/bVjIWe12VKk

5. GITHUB LINK OF THIS DA

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“This assignment submission is my own, original work”.
Elizabeth Heider