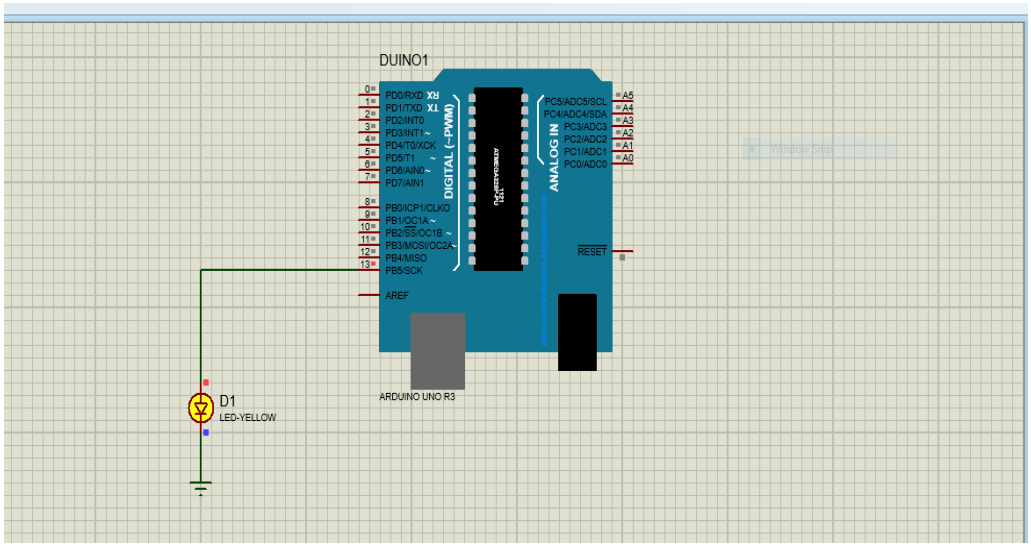
Lab Task # 01

Q: Write a program to blink built-in LED (Pin No.13, PB5) on UNO board at a frequency of 4 Hz with 50 % duty cycle?

Code:

```
#define LED 5

void setup( )

{

DDRB |= (1<<LED);

}

void loop( )

{

PORTB &= ~(1<<LED);

delay(500);

PORTB |= (1<<LED);

delay(500);

}
```



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Lab No#02

Q1.: Show decimal numbers from 0 to 99 on two seven segment displays?

Code:

```
#define SEG0 8

#define SEG1 9

byte Count;

byte Seven_Segment[] ={0x3F, 0x06, 0x5B, 0x4F, 0x66,0x6D, 0x7D, 0x07, 0x7F, 0x6F};

void Display(byte No)

{  byte units, tens;

tens = No / 10;

units = No % 10;

for (int I = 0 ; I < 20 ; I++)

{  digitalWrite(SEG1,LOW);

PORTD = Seven_Segment[units];

digitalWrite(SEG0,HIGH);

delay(50);

digitalWrite(SEG0,LOW);

PORTD = Seven_Segment[tens];

digitalWrite(SEG1,HIGH);

delay(50);

}
```

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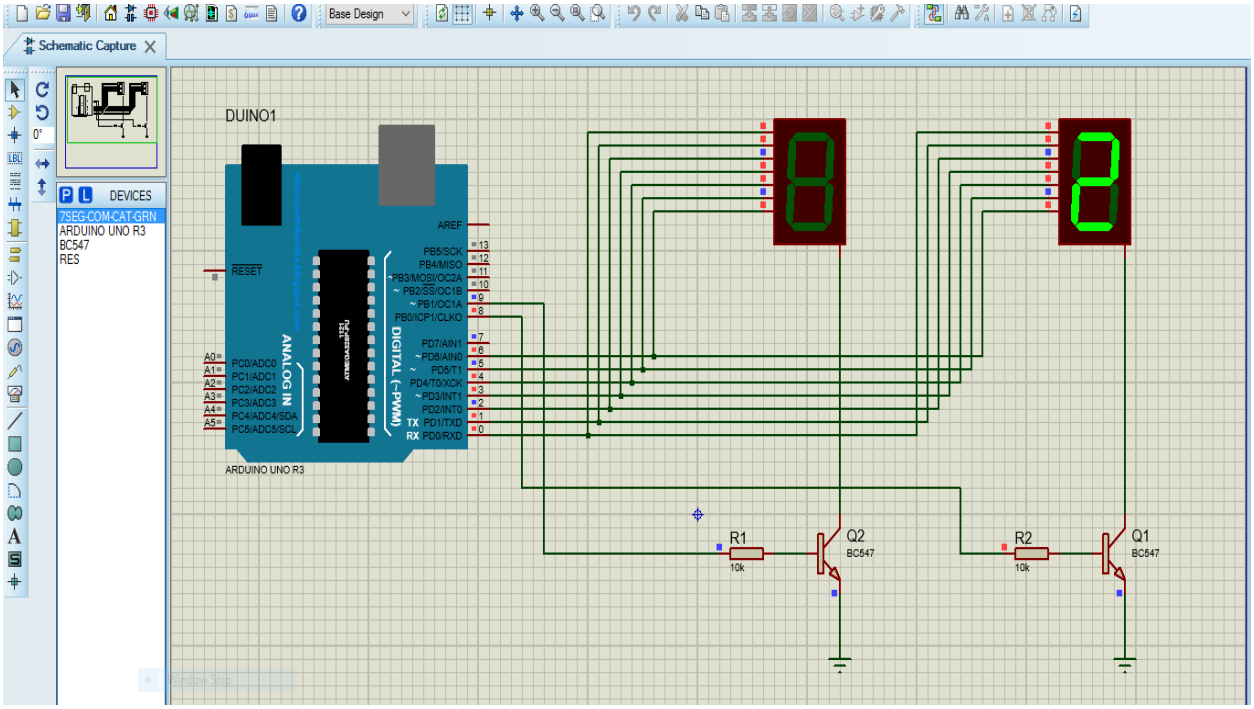
```
}
void setup()
{ DDRD = 0xFF;
pinMode(SEG0,OUTPUT);
pinMode(SEG1,OUTPUT);}
void loop(){
Display(Count++);
Count = 0;}
```



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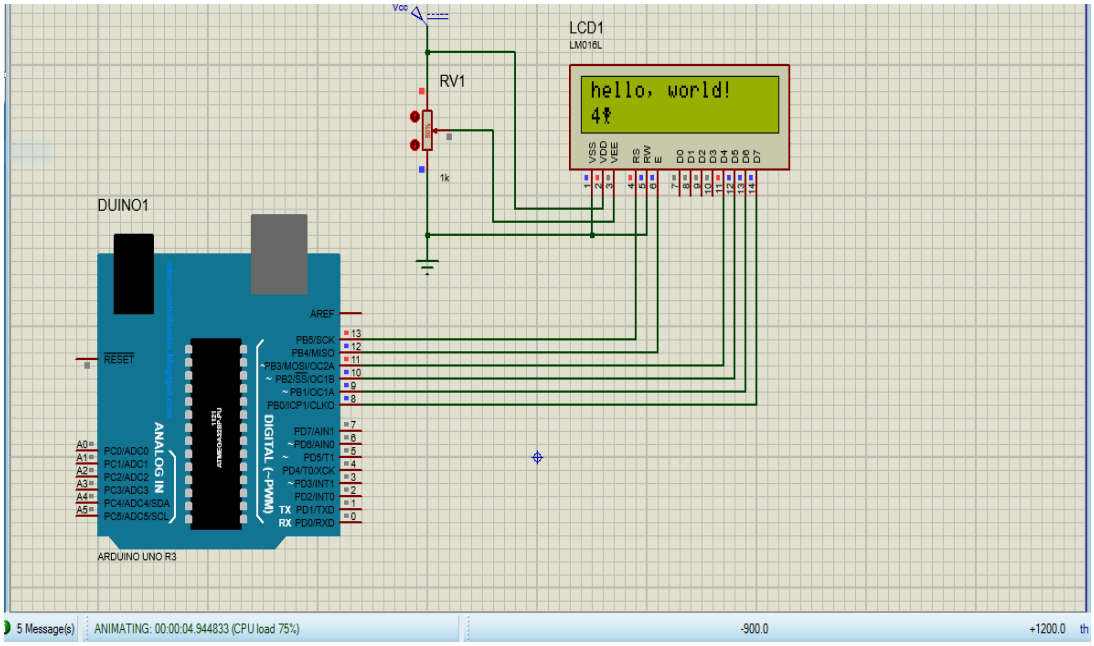
Q: Write a sketch to display “Hello World” in first line and a character in second line of LCD?

Code:

```
#include <LiquidCrystal.h>

const int RS = 13, E = 12, D4 = 11, D5 = 10, D6 = 9, D7 = 8;

LiquidCrystal lcd(RS, E, D4, D5, D6, D7);

byte k=0;

byte Shape0[8]=
{0b01110,0b01110,0b00100,0b01110,0b10101,0b00100,0b01010,0b01010};

byte Shape1[8]={ 0x0E,0x0E,0x15,0xE,0x04,0x04,0x0A,0x0A};

void setup()

{

lcd.begin(16, 2);

lcd.createChar(0, Shape0);

lcd.createChar(1, Shape1);

lcd.setCursor(0, 0);

lcd.print("hello, world!");

}

void loop()

{

lcd.setCursor(0, 1);

lcd.print( millis() / 1000);

lcd.write(byte(k++%2));
```

```
delay(500);
}
```

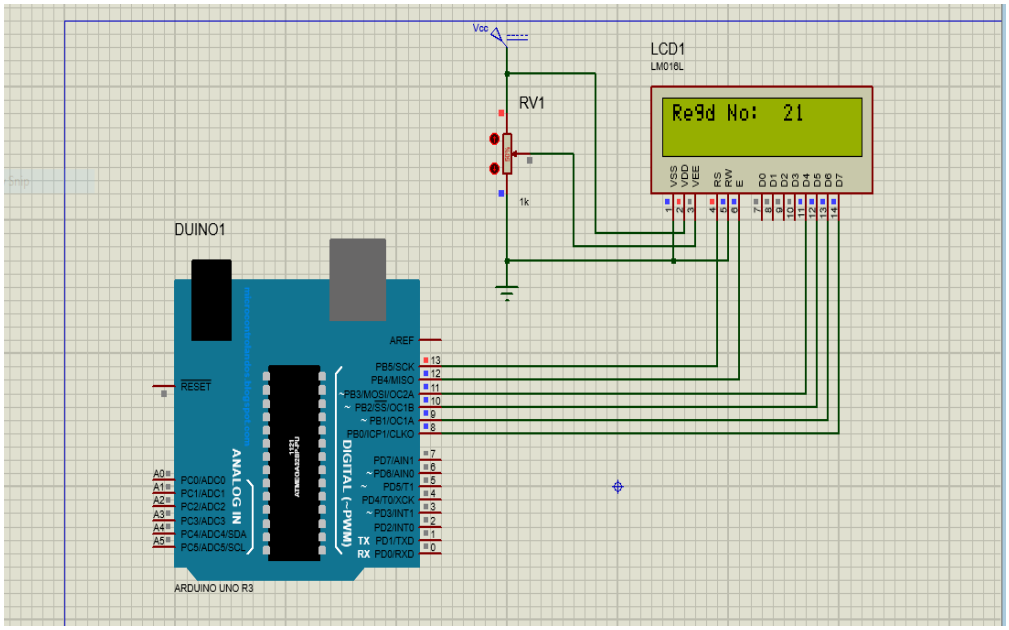


Q: Write a sketch to display your registration number in first line LCD?

Code:

```
#include <LiquidCrystal.h>
const int RS = 13, E = 12, D4 = 11, D5 = 10, D6 = 9, D7 = 8;
LiquidCrystal lcd(RS, E, D4, D5, D6, D7);
byte k=0;
byte Shape0[8]={0x17,0x14,0x17,0x18,0x00,0x00,0x00,0x00};
byte Shape1[8]={0x00,0x00,0x00,0x13,0x12,0x11,0x1F,0x00};
void setup(){
```

```
  lcd.begin(16,2);
  lcd.clear();
  lcd.createChar(0,Shape0);
  lcd.createChar(1,Shape1);
  lcd.setCursor(0,0);
  lcd.print("Regd No: 21");  }
void loop()
{  lcd.setCursor(0,1);
  lcd.print( millis() / 1000);
  lcd.write(byte(1));
  lcd.write(byte(0));
  delay(500);}
```



LAB 03

Code:

```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>
#include <Keypad.h>
#include <DHT.h>

// Define DHT11 sensor
#define DHTPIN 5
#define DHTTYPE DHT11
DHT dht(DHTPIN, DHTTYPE);

// Define PIR sensor
#define PIRPIN 11

// Initialize the LCD
LiquidCrystal_I2C lcd(0x27, 16, 2); // Adjust the address (0x27) if
needed

// Define the 4x3 keypad
const byte ROWS = 4;
const byte COLS = 4;
char keys[ROWS][COLS] = {
  {'1', '2', '3',},
  {'4', '5', '6',},
  {'7', '8', '9',},
  {'*', '0', '#',}
};
byte rowPins[ROWS] = {9, 8, 7, 6}; // Connect to the row pins of the
keypad
byte colPins[COLS] = {4, 3, 2}; // Connect to the column pins of the
keypad
Keypad keypad = Keypad(makeKeymap(keys), rowPins, colPins, ROWS,
COLS);

void setup() {
  // Initialize LCD
  lcd.begin();
  lcd.backlight();
  lcd.print("System Initializing");

  // Initialize DHT sensor
  dht.begin();

  // Initialize PIR sensor
  pinMode(PIRPIN, INPUT);

  // Wait for 2 seconds
```

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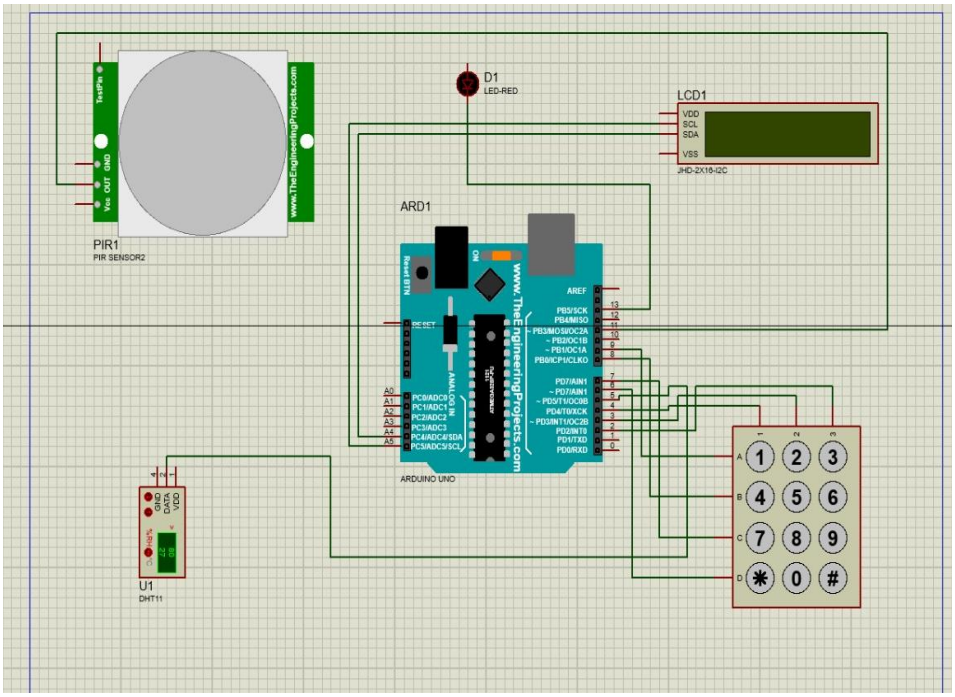
```
  delay(2000);
  lcd.clear();
  lcd.print("Ready");
  delay(1000);
}

void loop() {
  // Read keypad input
  char key = keypad.getKey();
  if (key) {
    lcd.clear();
    if (key == '1') {
      // Read PIR sensor
      int pirState = digitalRead(PIRPIN);
      if (pirState == HIGH) {
        lcd.print("Motion: Detected");
      } else {
        lcd.print("Motion: None");
      }
    } else if (key == '2') {
      // Read temperature and humidity from DHT11
      float temperature = dht.readTemperature();
      float humidity = dht.readHumidity();

      // Check if the readings are valid
      if (isnan(temperature) || isnan(humidity)) {
        lcd.print("Sensor Error");
      } else {
        lcd.print("Temp: ");
        lcd.print(temperature);
        lcd.print("C");
        lcd.setCursor(0, 1);
        lcd.print("Humidity: ");
        lcd.print(humidity);
        lcd.print("%");
      }
    } else {
      lcd.print("Invalid Key");
    }
    delay(2000);
    lcd.clear();
  }
}
```

Schematics:



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Lab No 4

Q: Using Timer0 write a program to generate a Frequency 39.06 Hz on PB5 using Normal Mode or CTC Mode

Code:

```
const int outputPin = 13;  // Built-in LED pin (PB5)
const int inputPin = 2;    // Input pin for frequency measurement

volatile unsigned long lastRisingEdge = 0;
volatile unsigned long period = 0;
volatile bool newMeasurement = false;

void setup() {
  // Initialize serial communication
  Serial.begin(9600);

  // Configure Timer0 for CTC mode
  pinMode(outputPin, OUTPUT);
  TCCR0A = 0;
  TCCR0B = 0;
  TCNT0 = 0;

  // Set CTC mode and toggle OC0A on Compare Match
  TCCR0A |= (1 << WGM01) | (1 << COM0A0);
```

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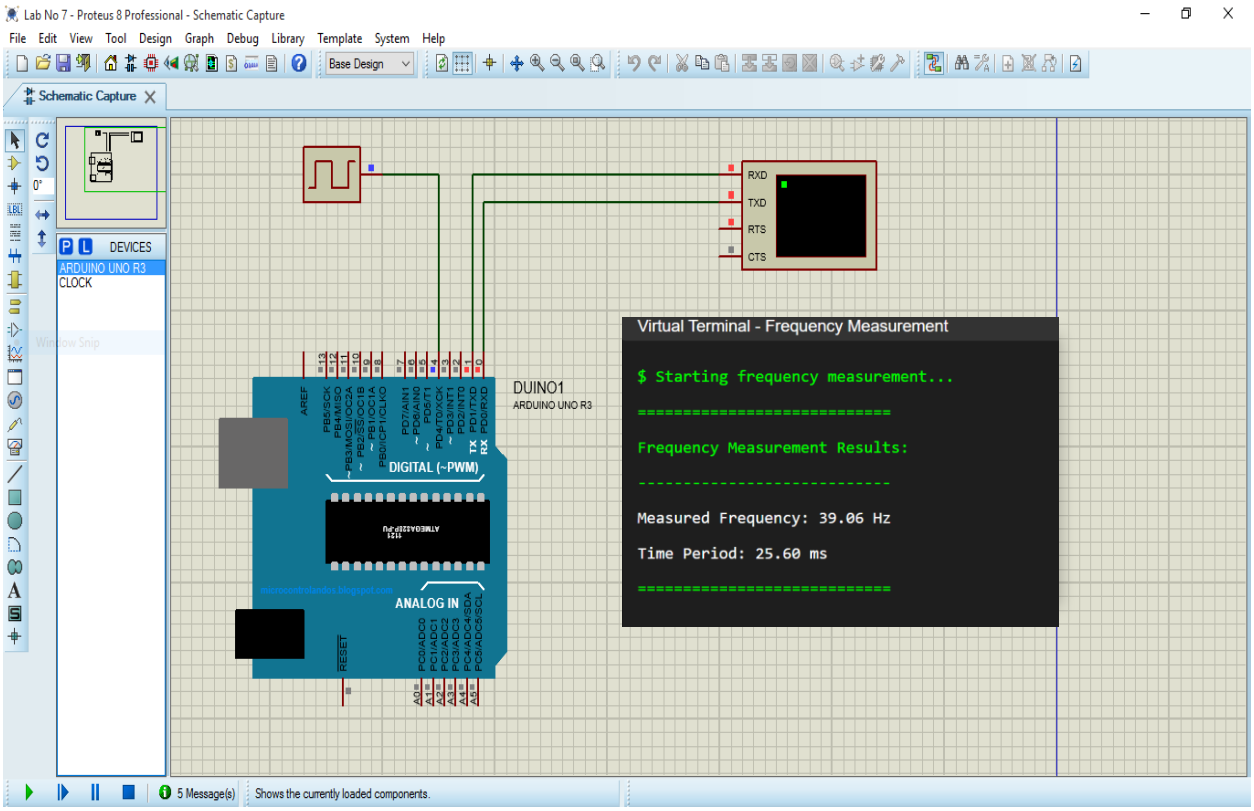
```
  // Set prescaler to 1024
  TCCR0B |= (1 << CS02) | (1 << CS00);

  // Set OCR0A for 39.06 Hz
  OCR0A = 200;

  // Configure input pin for measurement
  pinMode(inputPin, INPUT);
  attachInterrupt(digitalPinToInterrupt(inputPin), measurePeriod, RISING);

  // Display initial terminal header
  displayTerminalHeader();
}

void loop() {
  static unsigned long lastDisplay = 0;
  const unsigned long displayInterval = 1000;  // Update every second

  if (millis() - lastDisplay >= displayInterval) {
    displayMeasurements();
    lastDisplay = millis();
  }
}
```

```
void measurePeriod() {
  unsigned long currentTime = micros();
  period = currentTime - lastRisingEdge;
  lastRisingEdge = currentTime;
  newMeasurement = true;
}

void displayTerminalHeader() {
  Serial.println("\n$ Starting frequency measurement...");
  Serial.println("============================");
  Serial.println("Frequency Measurement Results:");
  Serial.println("----------------------------");
}

void displayMeasurements() {
  // Clear previous lines (ANSI escape codes)
  Serial.println("\033[2J\033[H");  // Clear screen and move cursor to home

  displayTerminalHeader();

  // Calculate and display frequency
  float freq = 1000000.0 / period;  // Convert microseconds to Hz
  float timePeriod = period / 1000.0;  // Convert to milliseconds

  // Format and display measurements
```

```
Serial.print("Measured Frequency: ");
Serial.print(freq, 2);  // Display with 2 decimal places
Serial.println(" Hz");

Serial.print("Time Period: ");
Serial.print(timePeriod, 2);  // Display with 2 decimal places
Serial.println(" ms");

Serial.println("============================");
                                                }
```



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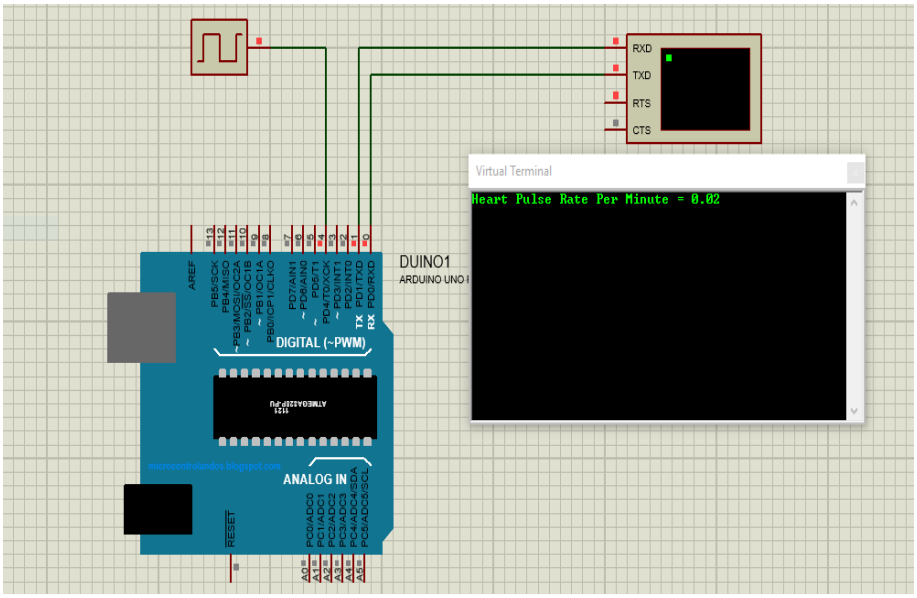
Q: Heart pulses of a patient, in the form of square wave are reaching at Pin T0 (PD4) (Arduino PIN 4) of Arduino UNO Board. Write a program to measure the current pulse rate per minute of that patient after each 20 seconds and send this answer via serial port to Computer?

Code:

```
void T1_Delay()
{
  TCNT1  = 0x0000;
  OCR1A  = 15625 - 1;
  TCCR1A = 0x00;
  TCCR1B = 0x0D;
  while ((TIFR1 & (1<<OCF1A))==0);
  TCCR1B  = 0;
  TIFR1  |=  1<<OCF1A;
}
void setup()
{
  Serial.begin(9600);
  DDRD&=~(1<<4);
  PORTD|=(1<<4);
  SREG&=(1<<7);
}
```

```
void loop()
{
  TCNT0=0x00;
  TCCR0A=0x00;
  TCCR0B=0X06;
  for(int i=0;i<20;i++)
  {T1_Delay();}
  TCCR0B=0x00;
  float Tp=1/TCNT1;
  float Tp1=Tp/60;
  Serial.print("Heart Pulse Rate Per Minute = ");
  Serial.println(Tp1);
}
```



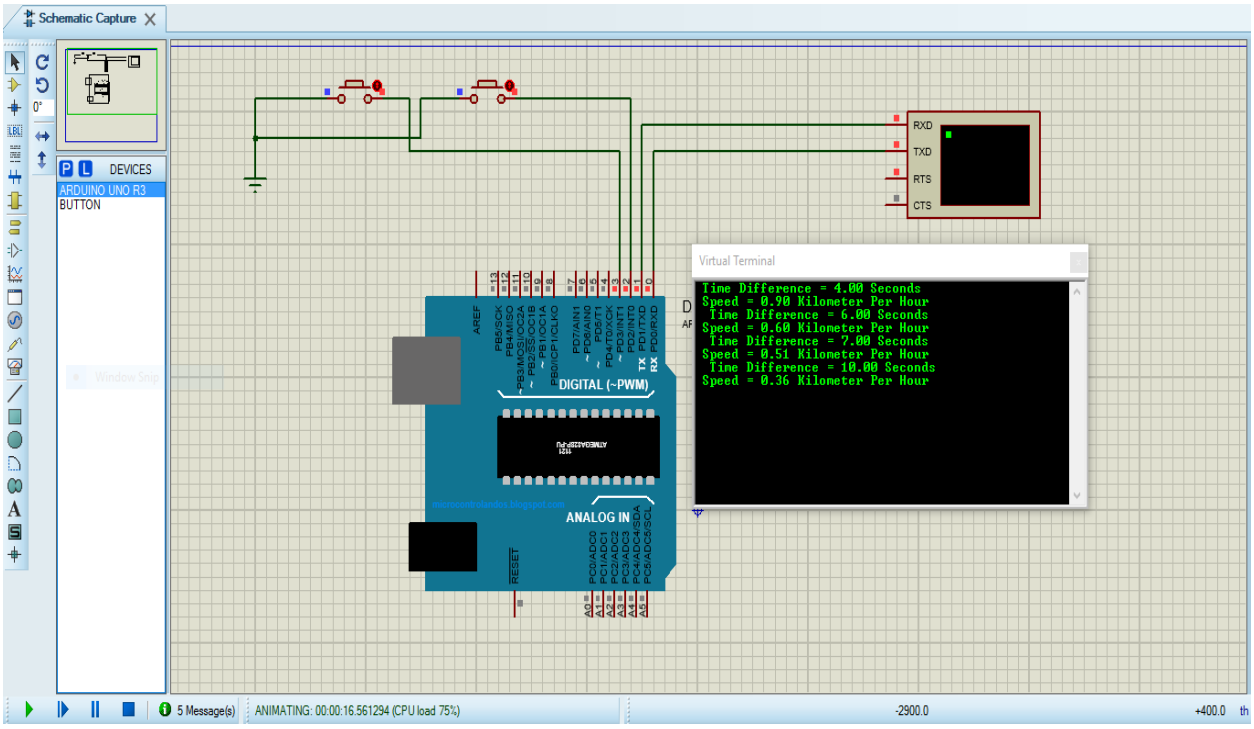
Lab Task #06

Q: Two IR sensors at a distance of 1 meter are placed on a road. Sensor0 is connected to INT0 interrupt pin and Sensor1 is connected to INT1 interrupt pin. A moving car crosses the Sensor0 first and then Sensor1. Calculate the time difference between two sensors detection and then the speed of that Car in Kilometer per Hour Units. Send these two answers via serial port to PC.

Code:

```
unsigned long Sensor0 = 0;
unsigned long Sensor1 = 0;
unsigned long Time;
float Time_In_Seconds;
float Distance = 1; // 1 Meter
float Speed;
float Speed_In_Km_Per_Hour;
void setup()
{
Serial.begin(9600);
DDRD = DDRD & 0b11110011;
PORTD = PORTD | 0b00001100;
EIMSK = EIMSK | 0b00000011;
EICRA = 0b00001010;
```

```
SREG = SREG | (1 << 7);
}
void loop()
{
}
ISR(INT0_vect)
{
Sensor0 = millis();
}
ISR(INT1_vect)
{
Sensor1 = millis();
Time = Sensor1 - Sensor0;
Time_In_Seconds = Time/1000;
Speed = Distance/Time_In_Seconds;
Speed_In_Km_Per_Hour = (Speed*3600)/1000;
Serial.print(" Time Difference = ");
Serial.print(Time_In_Seconds);
Serial.print(" Seconds\n\r ");
Serial.print("Speed = ");
Serial.print(Speed_In_Km_Per_Hour);
Serial.print(" Kilometer Per Hour\n\r ");
delay(200000);}
```



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Task 7

```
#define STEP_SIZE (1.1 / 1024) // Define step size for ADC conversion

void setup() {
  Serial.begin(9600);  // Initialize Serial communication at 9600 bits per second
  DDRC = 0x00;         // Make Port C an input for ADC input
  ADCSRA = 0x87;       // Enable ADC and select CLK/128
  ADMUX = 0xC0;        // 1.1V Vref, Select ADC0, right-justified
}

void loop() {
  ADCSRA |= (1 << ADSC);  // Start conversion
  while ((ADCSRA & (1 << ADIF)) == 0)
    ;                     // Wait for conversion to finish
  ADCSRA |= (1 << ADIF);  // Clear ADIF flag by writing 1 to it

  Serial.print("ADC = ");
  Serial.print(ADC);  // Send ADC value serially

  Serial.print(" Vin = ");
  Serial.print(float(ADC) * STEP_SIZE);  // Show input voltage

  float C = float(ADC) * STEP_SIZE * 100;  // Calculate temperature in Celsius
  Serial.print(" Temperature in Centigrade is C = ");
  Serial.println(C);  // Show temperature in Centigrade

  delay(1000);  // Wait for 1 second
}
```

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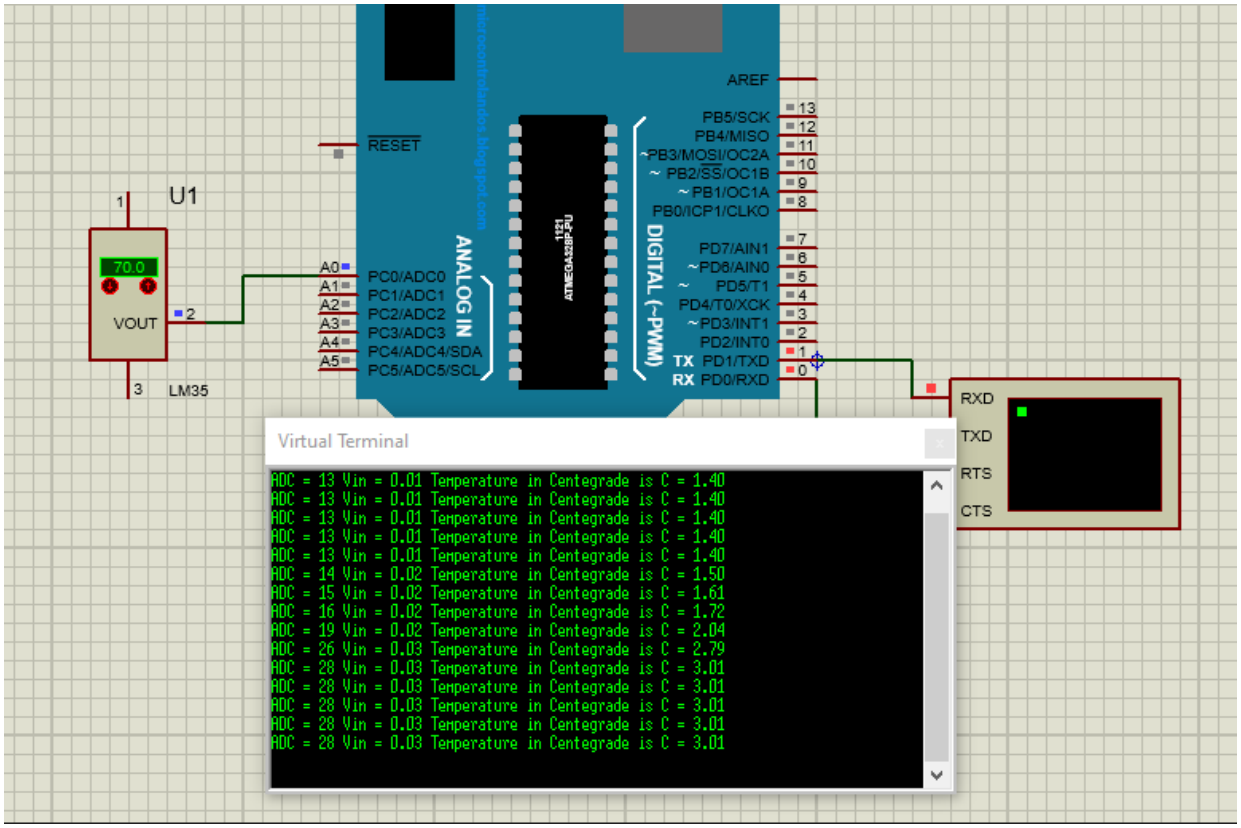

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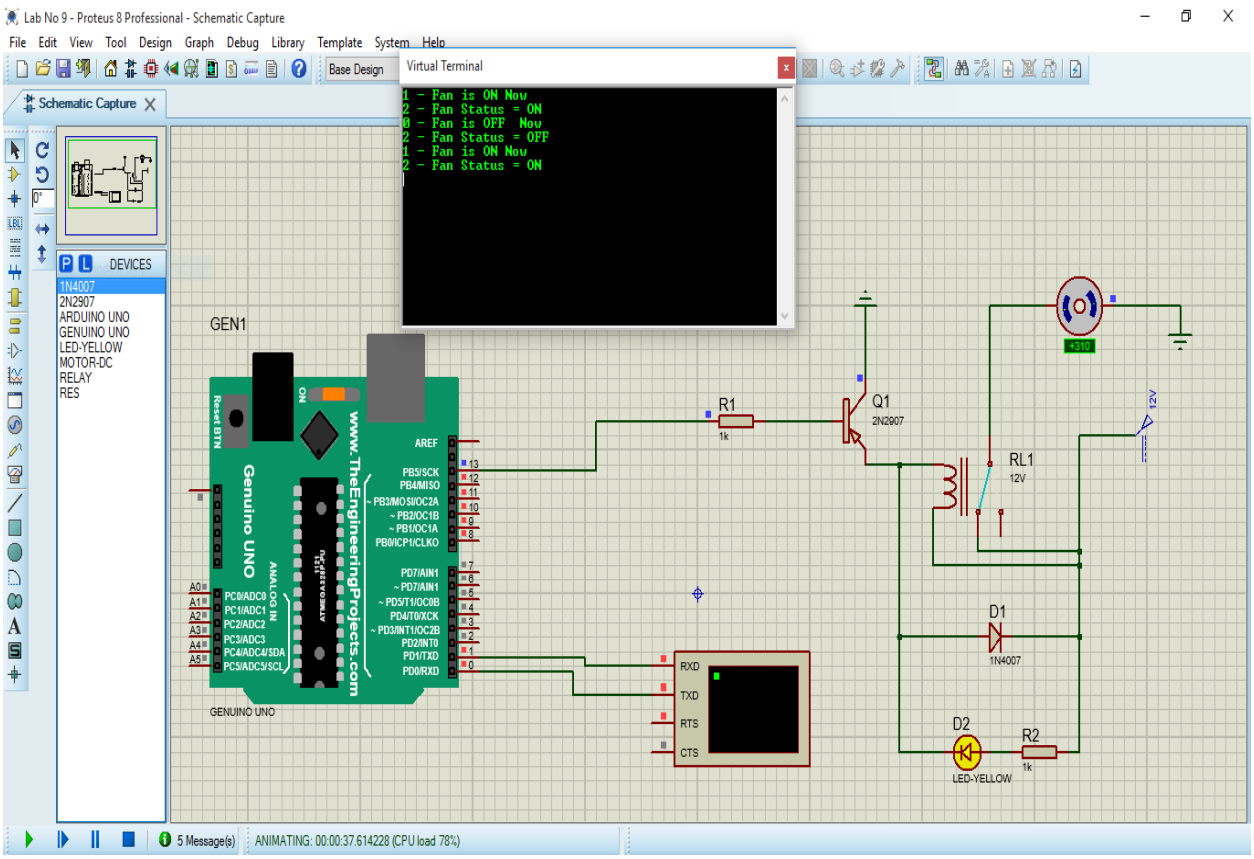
Lab No 9

Code:

```
void setup()
{
  DDRB  = 0xFF;
  PORTB = 0xFF;
  Serial.begin(9600);
}
void loop()
{
  if (Serial.available())
  {
    int inByte = Serial.read();
    switch(inByte)
    {
      case '0':                  // if received byte is '1' = 0x31
            PORTB |=  (1<<5);     // Turn ON LED
            Serial.println("0 - Fan is OFF  Now");
            break;
      case '1':                  // if received byte is '0' = 0x30
            PORTB &= ~(1<<5);     // Turn OFF LED
            Serial.println("1 - Fan is ON Now");
```

```
        break;
    case '2':                   // if received byte is '2' = 0x32
        if(PORTB &(1<<5)) Serial.println("2 - Fan Status = OFF");
        else              Serial.println("2 - Fan Status = ON");
        break;
    default:                    // if received byte is defferent
        Serial.write(inByte);
        Serial.println(" - is Unrecognized Command");
   }
 }
}
```



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Lab Task5

Q: An LED is connected to Arduino Pin No.13(PB5). Write a Program that that receives a byte serially and acts according to following table?

Received Byte	Action to Perform
'0'	Turn OFF LED and send back message
'1'	Turn ON LED and send back message
'2'	Turn ON LED 2 times with some delay and send back message
'3'	Turn ON LED 3 times with some delay and send back message
'4'	Turn ON LED 4 times with some delay and send back message
'9'	Send back message about the (ON/OFF) status of LED
Any other byte	Send back message that this byte is not a valid command

Code:

```
#define FOSC 16000000UL   // Clock Speed
#define BAUD     9600
#define MYUBRR   FOSC/16/BAUD - 1
```

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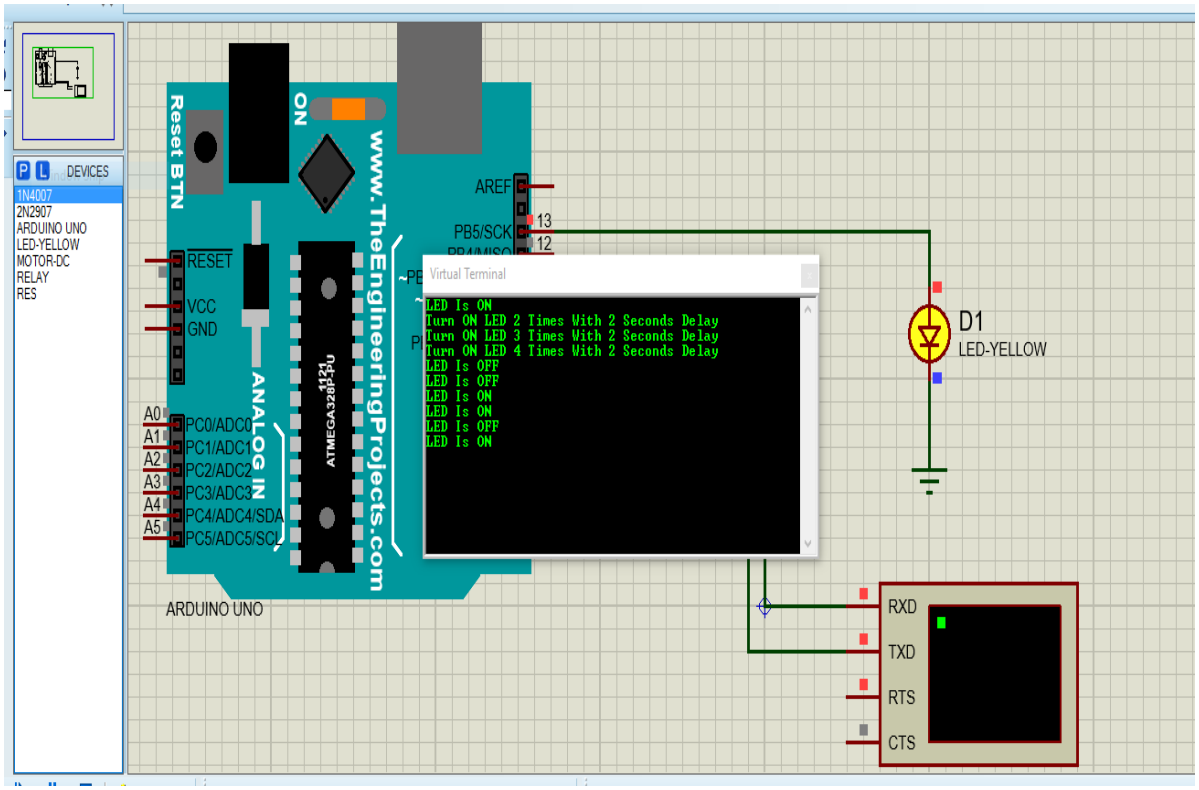
```
void USART_Init()
{
  UBRR0H = MYUBRR >> 8;  // Set baud rate
  UBRR0L = MYUBRR;       // UBRR0L = 103
  UCSR0B = (1<<RXEN0 )|(1<<TXEN0 ); // Enable receiver and transmit.
  UCSR0C = (1<<UCSZ01)|(3<<UCSZ00); // 8 data bits, 1 stop bit
}
byte USART_Receive()
{
  while ( !(UCSR0A & (1<<RXC0)) );  // Wait for data to be received
  return UDR0;      // Return received data
}
void USART_Send_Str (byte data[])
{
  for (int i = 0 ; data[i]; i++ )
  {
    while (! (UCSR0A & (1<<UDRE0))); // wait until UDR0 is empty
    UDR0 = data[i];  // transmit data
  }
}
void setup()
{
```

```
  USART_Init();
  DDRB |= (1<<5);
  }
  void loop()
  {
    byte A = USART_Receive();
    switch (A)
    {
    case '0':
    PORTB &= ~(1<<5);
    USART_Send_Str ("LED Is OFF\n\r"); break;
    case '1':
    PORTB |= (1<<5);
    USART_Send_Str ("LED Is ON\n\r"); break;
    case '2':
    USART_Send_Str ("Turn ON LED 2 Times With 2 Seconds
Delay\n\r");
    PORTB |= (1<<5);
    delay(2000);
    PORTB &= ~(1<<5);
    delay(2000);
    PORTB |= (1<<5);
    delay(2000);
```

```
    PORTB &= ~(1<<5);
    delay(2000);
    break;
    case '3':
    USART_Send_Str ("Turn ON LED 3 Times With 2 Seconds Delay\n\r");
    PORTB |= (1<<5);
    delay(2000);
    PORTB &= ~(1<<5);
    delay(2000);
    PORTB |= (1<<5);
    delay(2000);
    PORTB &= ~(1<<5);
    delay(2000);
    PORTB |= (1<<5);
    delay(2000);
    PORTB &= ~(1<<5);
    delay(2000);
    break;
    case '4':
    USART_Send_Str ("Turn ON LED 4 Times With 2 Seconds Delay\n\r");
    PORTB |= (1<<5);
    delay(2000);
```

```
PORTB &= ~(1<<5);
delay(2000);
PORTB |= (1<<5);
delay(2000);
PORTB &= ~(1<<5);
delay(2000);
PORTB |= (1<<5);
delay(2000);
PORTB &= ~(1<<5);
delay(2000);
PORTB |= (1<<5);
delay(2000);
PORTB &= ~(1<<5);
delay(2000);
break;
case '9':
if ((PORTB &= (1<<5)))
{
  USART_Send_Str ("LED Is ON\n\r");
}
else USART_Send_Str ("LED Is OFF\n\r");
break;
default:
```

```
  USART_Send_Str ("Error!!! Invalid Command.\n\r");
  }
}
```



LAB 08

```
#define SCK 5   // Shift Clock is PB5
#define MISO 4  // Master In Slave Out is PB4
#define MOSI 3  // Master Out Slave In is PB3
#define SS 2    // Slave Select is PB2
void SPI_Begin() {
  // Set MOSI, SCK, and SS as Output Pins
  DDRB |= (1 << MOSI) | (1 << SCK) | (1 << SS);
  DDRB &= ~(1 << MISO); // Set MISO as an Input Pin
  // Enable SPI, Master mode, Shift Clock = CLK /16
  SPCR = (1 << SPE) | (1 << MSTR) | (1 << SPR0);
  PORTB &= ~(1 << SS); }
void SPI_Send_String(const char* str) {
  while (*str) {
    SPI_Transfer(*str++);  }
  SPI_Transfer('\0');}
byte SPI_Transfer(byte data) {
  SPDR = data; // Start transmission
  while (!(SPSR & (1 << SPIF))); // Wait for transmission complete
  return SPDR;}
void setup() {
  Serial.begin(9600);
  SPI_Begin();
  Serial.println("SPI Master");}
void loop() {
  delay(1000); // Call one-second delay
  Serial.println("Sending: SPI is working");
  SPI_Send_String("SPI is working"); // Send the string to the Slave
  delay(1000);}
```

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```
// slave
#define SCK 5   // Shift Clock is PB5
#define MISO 4  // Master In Slave Out is PB4
#define MOSI 3  // Master Out Slave In is PB3
#define SS 2    // Slave Select is PB2
void SPI_Begin_Slave() {
  DDRB |= (1 << MISO); // Set MISO as an Output Pin
  DDRB &= ~((1 << MOSI) | (1 << SCK) | (1 << SS));
  SPCR = (1 << SPE); // Enable SPI as a Slave Device
}
byte SPI_Receive() {
  while (!(SPSR & (1 << SPIF))); // Wait for reception complete
  return SPDR; }
void setup() {
  Serial.begin(9600);
  SPI_Begin_Slave();
  Serial.println("SPI Slave");}
void loop() {
  char received[50]; // Buffer to store received string
  byte i = 0;
  char data;
  do {
    data = SPI_Receive();
    received[i++] = data;
  } while (data != '\0' && i < 50);
  received[i - 1] = '\0'; // Null-terminate the string
  Serial.print("Received: ");
  Serial.println(received);}
```

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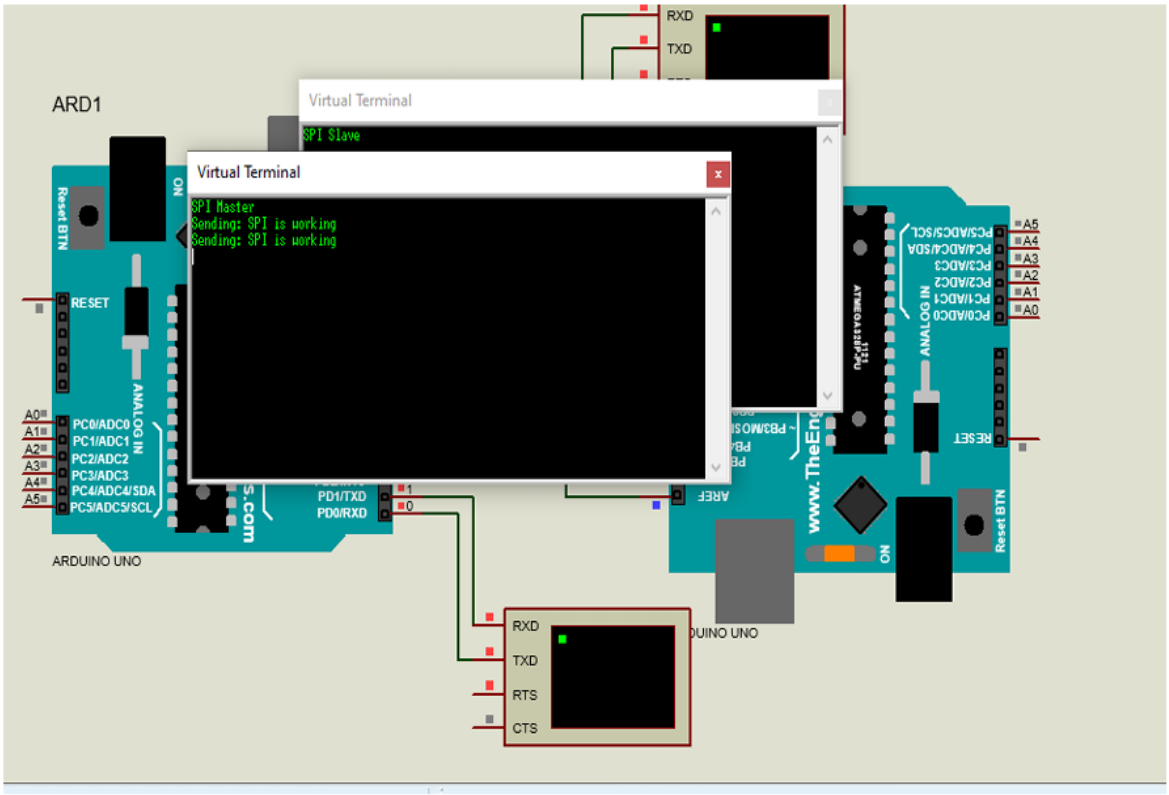

Name: Muhammad Yaseen
Roll No# 21-Fet-Bsce-22

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