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XD-58C pulse sensor pulse heart rate sensor XD58C For Arduino

Introduction:

A pulse wave is the change in the volume of a blood vessel that occurs when the heart pumps blood, and a detector that monitors this volume change is called a pulse sensor.An alternate name of this sensor is heartbeat sensor or heart rate sensor. The working of this sensor can be done by connecting it from the fingertip or human ear to Arduino board. So that heart rate can be easily calculated.

A pulse sensor is a hardware device that can be used to measure heart rate in real-time. When paired with an Arduino microcontroller, you can create a simple yet effective heart rate monitor. This sensor is quite easy to use and operate. Place your finger on top of the sensor and it will sense the heartbeat by measuring the change in light from the expansion of capillary blood vessels.

Features:

- Maximum current:100 mA
- Heartbeat Dedicated output: LED
- VCC +5V (high quality regulation)
- Light source : 660nm super Red LED
- Output data level : 5V TTL

Specifications:

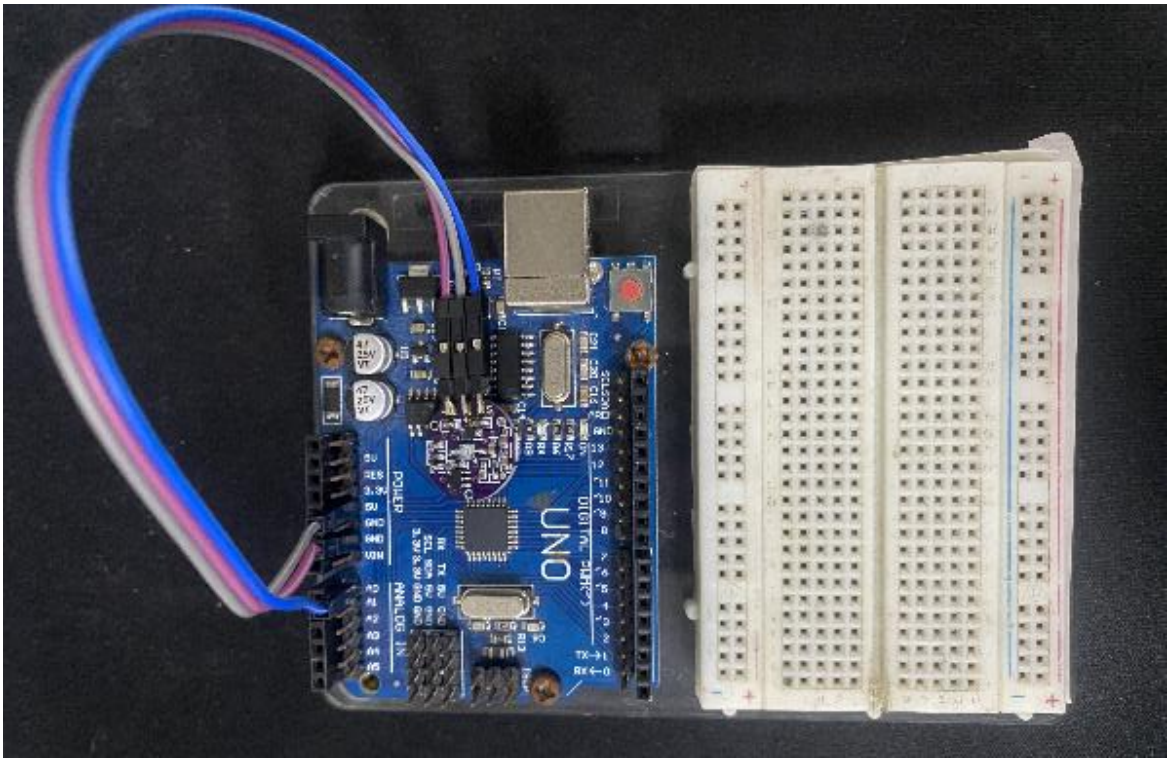
- This is a hear beat detecting and biometric pulse rate sensor
- Its diameter is 0.625
- Its thickness is 0.125
- The operating voltage is ranges +5V otherwise +3.3V
- This is a plug and play type sensor
- The current utilization is 4mA

Objective

In this project, we will interface Pulse Sensor with Arduino to Measure Pulse Rate (BPM) or Heart Beat value. The Pulse rate will be displayed on 16×2 LCD Display.

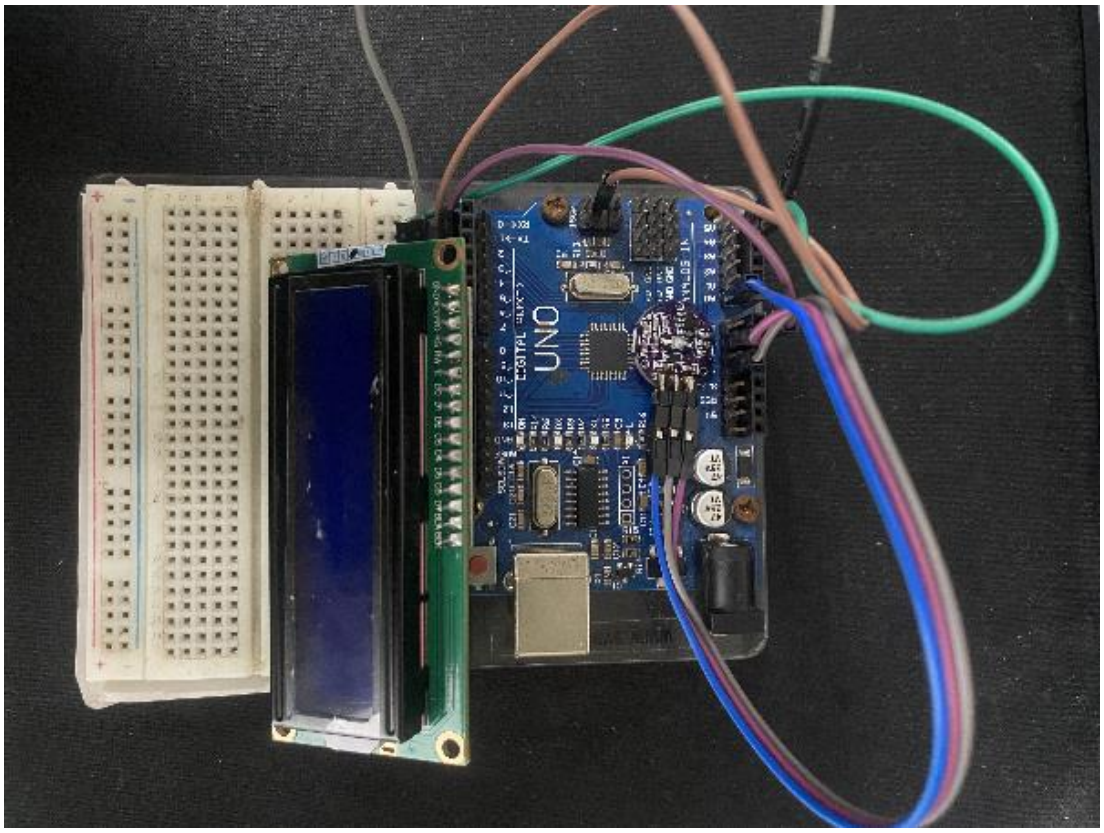
Procedures: -

Step 1: Pulse sensor has three pins: GND, Signal, and VCC. The GND pin is connected to ground, the signal pin is connected to A0, and the VCC is the power supply.



Step 2: Connect the LCD Display to the breadboard based on table below: -

Arduino	LCD Display
VCC	VCC / 5V
GND	GND
SDA	A4
SCL	A5



Step 3: Open Arduino IDE on PC and insert the given code below.

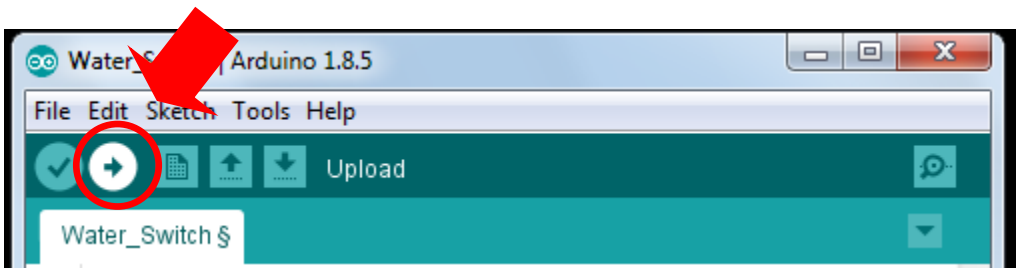
```
#include <Wire.h>
#include <LiquidCrystal_I2C.h>

LiquidCrystal_I2C lcd(0x27, 16, 2); // to check your i2c address  upload i2c scanner to the board
int pulsePin = A0;                 // Pulse Sensor purple wire connected to analog pin A0
int blinkPin = 13;                // pin to blink led at each beat

// Volatile Variables, used in the interrupt service routine!
volatile int BPM;                   // int that holds raw Analog in 0. updated every 2mS
volatile int Signal;                // holds the incoming raw data
volatile int IBI = 600;             // int that holds the time interval between beats! Must be seeded!
volatile boolean Pulse = false;     // "True" when User's live heartbeat is detected. "False" when not a "live beat".
volatile boolean QS = false;        // becomes true when Arduoino finds a beat.

static boolean serialVisual = true;   // Set to 'false' by Default.  Re-set to 'true' to see Arduino Serial Monitor ASCII Visual Pulse

volatile int rate[10];                    // array to hold last ten IBI values
volatile unsigned long sampleCounter = 0;          // used to determine pulse timing
volatile unsigned long lastBeatTime = 0;           // used to find IBI
volatile int P = 512;                     // used to find peak in pulse wave, seeded
volatile int T = 512;                     // used to find trough in pulse wave, seeded
volatile int thresh = 525;                // used to find instant moment of heart beat, seeded
volatile int amp = 100;                   // used to hold amplitude of pulse waveform, seeded
volatile boolean firstBeat = true;        // used to seed rate array so we startup with reasonable BPM
volatile boolean secondBeat = false;      // used to seed rate array so we startup with reasonable BPM

void setup()
{
  pinMode(blinkPin,OUTPUT);         // pin that will blink to your heartbeat!
  Serial.begin(115200);
  // we agree to talk fast!
  interruptSetup();                 // sets up to read Pulse Sensor signal every 2mS
                            // IF YOU ARE POWERING The Pulse Sensor AT VOLTAGE LESS THAN THE BOARD VOLTAGE,
                            // UN-COMMENT THE NEXT LINE AND APPLY THAT VOLTAGE TO THE A-REF PIN
                            //   analogReference(EXTERNAL);
  lcd.init();//if you can not upload this code lcd.init(); and change to lcd.begin();
  lcd.backlight();
}


//  Where the Magic Happens
void loop()
{
   serialOutput();

  if (QS == true) // A Heartbeat Was Found
    {
      // BPM and IBI have been Determined
      // Quantified Self "QS" true when arduino finds a heartbeat
      serialOutputWhenBeatHappens(); // A Beat Happened, Output that to serial.
      QS = false; // reset the Quantified Self flag for next time
    }
```

```
  delay(20); //  take a break
}


void interruptSetup()
{
  // Initializes Timer2 to throw an interrupt every 2mS.
  TCCR2A = 0x02;     // DISABLE PWM ON DIGITAL PINS 3 AND 11, AND GO INTO CTC MODE
  TCCR2B = 0x06;     // DON'T FORCE COMPARE, 256 PRESCALER
  OCR2A = 0X7C;      // SET THE TOP OF THE COUNT TO 124 FOR 500Hz SAMPLE RATE
  TIMSK2 = 0x02;     // ENABLE INTERRUPT ON MATCH BETWEEN TIMER2 AND OCR2A
  sei();             // MAKE SURE GLOBAL INTERRUPTS ARE ENABLED
}

void serialOutput()
{   // Decide How To Output Serial.
 if (serialVisual == true)
  {
    arduinoSerialMonitorVisual('-', Signal);   // goes to function that makes Serial Monitor Visualizer
  }
 else
  {
     sendDataToSerial('S', Signal);     // goes to sendDataToSerial function
   }
}

void serialOutputWhenBeatHappens()
{
 if (serialVisual == true) //  Code to Make the Serial Monitor Visualizer Work
   {
    Serial.print(" Heart-Beat Found ");  //ASCII Art Madness
    Serial.print("BPM: ");
    Serial.println(BPM);
    lcd.print("Heart-Beat Found ");
    lcd.setCursor(1,1);
    lcd.print("BPM: ");
    lcd.setCursor(5,1);
    lcd.print(BPM);
    delay(300);

    lcd.clear();

   }
 else
   {
    sendDataToSerial('B',BPM);   // send heart rate with a 'B' prefix
    sendDataToSerial('Q',IBI);   // send time between beats with a 'Q' prefix
   }
}

void arduinoSerialMonitorVisual(char symbol, int data )
{
  const int sensorMin = 0;      // sensor minimum, discovered through experiment
  const int sensorMax = 1024;    // sensor maximum, discovered through experiment
  int sensorReading = data; // map the sensor range to a range of 12 options:
  int range = map(sensorReading, sensorMin, sensorMax, 0, 11);
  // do something different depending on the
```

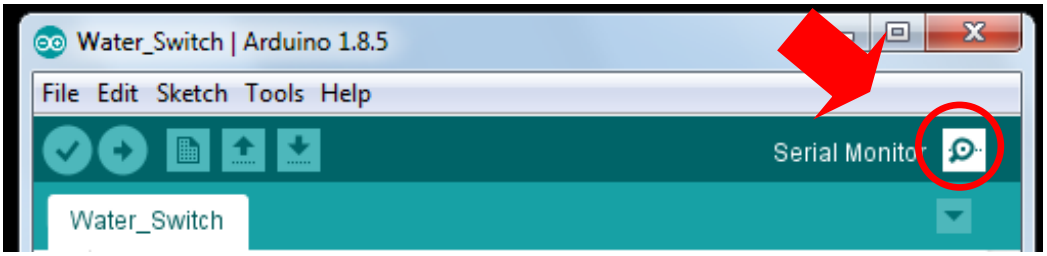
```
  // range value:
}


void sendDataToSerial(char symbol, int data )
{
   Serial.print(symbol);
   Serial.println(data);
}

ISR(TIMER2_COMPA_vect) //triggered when Timer2 counts to 124
{
  cli();                                // disable interrupts while we do this
  Signal = analogRead(pulsePin);              // read the Pulse Sensor
  sampleCounter += 2;                         // keep track of the time in mS with this variable
  int N = sampleCounter - lastBeatTime;       // monitor the time since the last beat to avoid noise
                                        //  find the peak and trough of the pulse wave
  if(Signal < thresh && N > (IBI/5)*3) // avoid dichrotic noise by waiting 3/5 of last IBI
    {
      if (Signal < T) // T is the trough
      {
        T = Signal; // keep track of lowest point in pulse wave
      }
    }

  if(Signal > thresh && Signal > P)
    {        // thresh condition helps avoid noise
      P = Signal;                             // P is the peak
    }                                     // keep track of highest point in pulse wave

  //  NOW IT'S TIME TO LOOK FOR THE HEART BEAT
  // signal surges up in value every time there is a pulse
  if (N > 250)
  {                                   // avoid high frequency noise
    if ( (Signal > thresh) && (Pulse == false) && (N > (IBI/5)*3) )
      {
        Pulse = true;                               // set the Pulse flag when we think there is a pulse
        digitalWrite(blinkPin,HIGH);                // turn on pin 13 LED
        IBI = sampleCounter - lastBeatTime;         // measure time between beats in mS
        lastBeatTime = sampleCounter;               // keep track of time for next pulse

        if(secondBeat)
        {                     // if this is the second beat, if secondBeat == TRUE
          secondBeat = false;                  // clear secondBeat flag
          for(int i=0; i<=9; i++) // seed the running total to get a realisitic BPM at startup
          {
            rate[i] = IBI;
          }
        }

        if(firstBeat) // if it's the first time we found a beat, if firstBeat == TRUE
        {
          firstBeat = false;                   // clear firstBeat flag
          secondBeat = true;                   // set the second beat flag
          sei();                               // enable interrupts again
          return;                              // IBI value is unreliable so discard it
        }
      // keep a running total of the last 10 IBI values
```

```
    word runningTotal = 0;                // clear the runningTotal variable

    for(int i=0; i<=8; i++)
     {             // shift data in the rate array
       rate[i] = rate[i+1];               // and drop the oldest IBI value
       runningTotal += rate[i];           // add up the 9 oldest IBI values
      }

    rate[9] = IBI;                       // add the latest IBI to the rate array
    runningTotal += rate[9];             // add the latest IBI to runningTotal
    runningTotal /= 10;                  // average the last 10 IBI values
    BPM = 60000/runningTotal;            // how many beats can fit into a minute? that's BPM!
    QS = true;                           // set Quantified Self flag
    // QS FLAG IS NOT CLEARED INSIDE THIS ISR
   }
  }

  if (Signal < thresh && Pulse == true)
   {  // when the values are going down, the beat is over
    digitalWrite(blinkPin,LOW);          // turn off pin 13 LED
    Pulse = false;                       // reset the Pulse flag so we can do it again
    amp = P - T;                         // get amplitude of the pulse wave
    thresh = amp/2 + T;                  // set thresh at 50% of the amplitude
    P = thresh;                          // reset these for next time
    T = thresh;
   }

  if (N > 2500)
   {                          // if 2.5 seconds go by without a beat
    thresh = 512;                        // set thresh default
    P = 512;                             // set P default
    T = 512;                             // set T default
    lastBeatTime = sampleCounter;        // bring the lastBeatTime up to date
    firstBeat = true;                    // set these to avoid noise
    secondBeat = false;                  // when we get the heartbeat back
   }

  sei();                                 // enable interrupts when youre done!
}// end isr
```

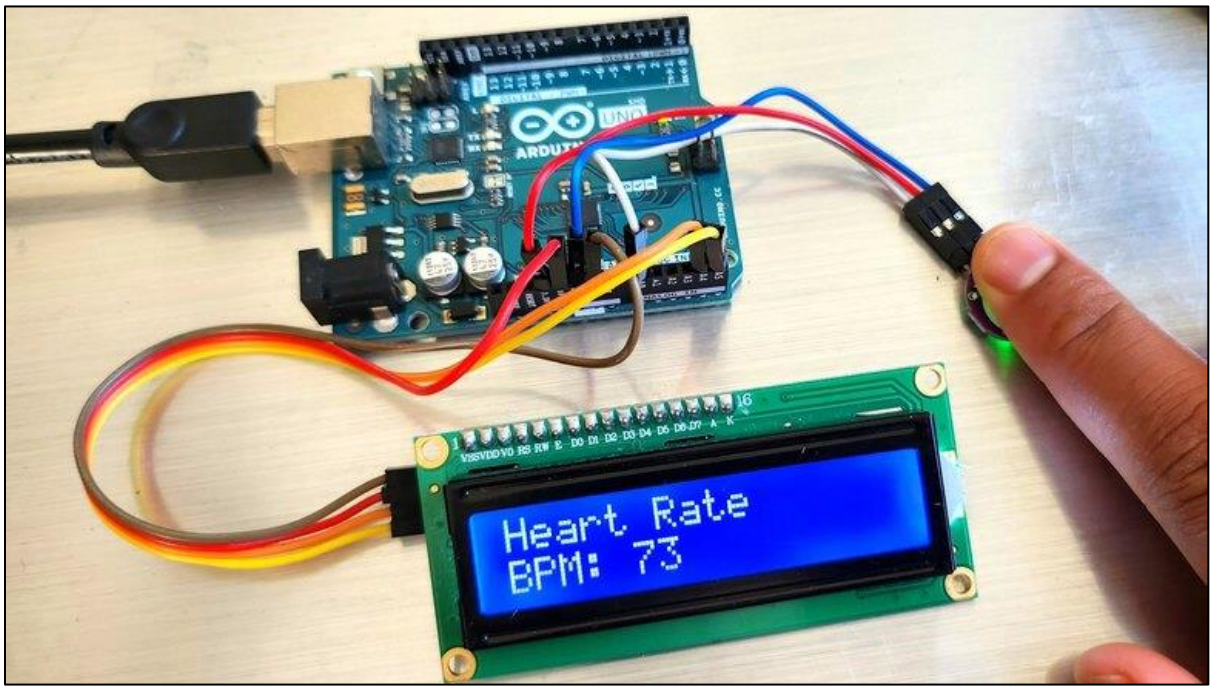
Step 4: After that, connect the Arduino UNO to the PC. Then click upload to start compiling and uploading program to the board.



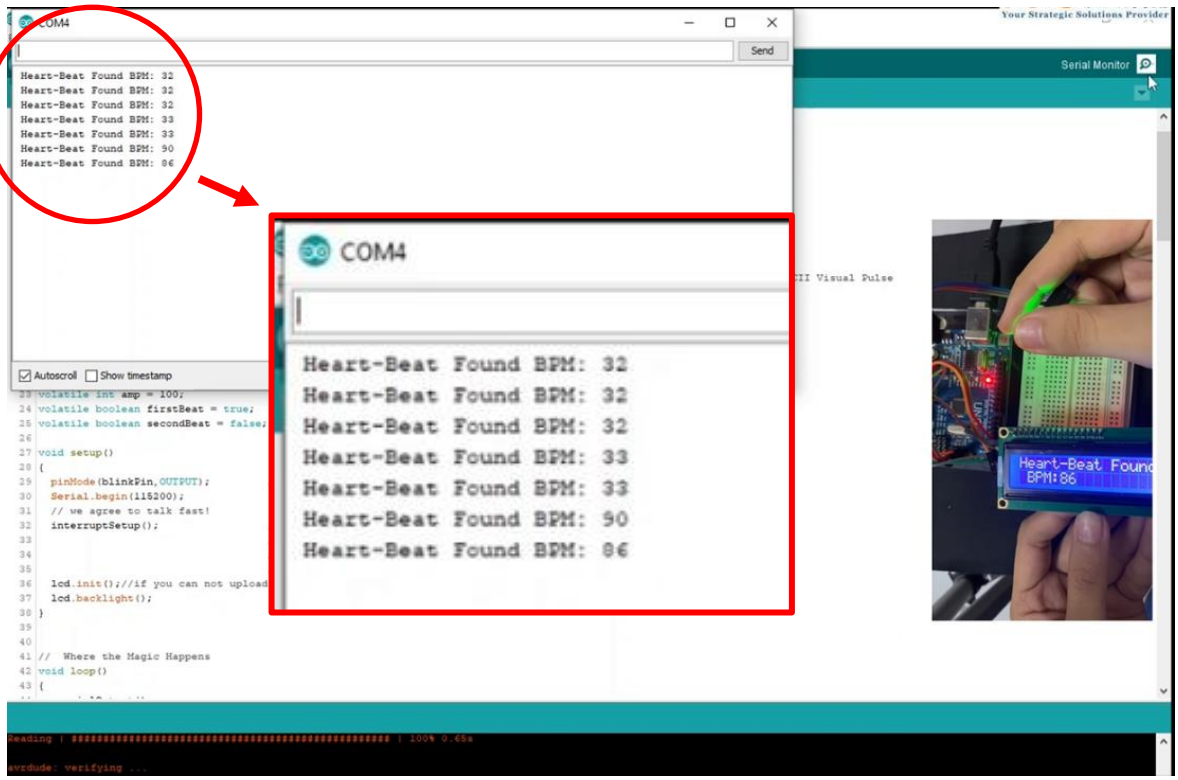
Step 5: After all step above completed, open the Serial Monitor.



Step 6: Place your finger on Pulse Sensor and you may see the BPM Value displayed on LCD Screen.



Step 7: After uploading the sketch, the readings may not be immediately accurate. To get reliable results, try to keep your finger as steady as possible while waiting.



Application: -

- This sensor is used for Sleep Tracking
- This sensor is used for Anxiety monitoring
- This sensor is used in remote patient monitoring or alarm system
- This sensor is used in Health bands
- This sensor is used in complex gaming consoles