#include <LiquidCrystal.h>

LiquidCrystal lcd(12, 11, 5, 4, 3, 2);

#include <SoftwareSerial.h>

float pulse = 0;

float temp = 0;

SoftwareSerial ser(9,10);

String apiKey = "JQ87I3X25FEIE22O";

// Variables

int pulsePin = A0; // Pulse Sensor purple wire connected to analog pin 0

int blinkPin = 7 ; // pin to blink led at each beat

int fadePin = 13; // pin to do fancy classy fading blink at each beat

int fadeRate = 0; // used to fade LED on with PWM on fadePin

// 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 nota "live beat".

volatile boolean QS = false; // becomes true when Arduoino finds a beat.

// Regards Serial OutPut -- Set This Up to your needs

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()

{

lcd.begin(16, 2);

pinMode(blinkPin,OUTPUT); // pin that will blink to your heartbeat!

pinMode(fadePin,OUTPUT); // pin that will fade to your heartbeat!

Serial.begin(115200); // we agree to talk fast!

interruptSetup(); // sets up to read Pulse Sensor signal every 2mS

lcd.clear();

lcd.setCursor(0,0);

lcd.print(" Patient Health");

lcd.setCursor(0,1);

lcd.print(" Monitoring ");

delay(4000);

lcd.clear();

lcd.setCursor(0,0);

lcd.print("Initializing....");

delay(5000);

lcd.clear();

lcd.setCursor(0,0);

lcd.print("Getting Data....");

ser.begin(9600);

ser.println("AT");

delay(1000);

ser.println("AT+GMR");

delay(1000);

ser.println("AT+CWMODE=3");

delay(1000);

ser.println("AT+RST");

delay(5000);

ser.println("AT+CIPMUX=1");

delay(1000);

String cmd="AT+CWJAP=\"Alexahome\",\"98765432\"";

ser.println(cmd);

delay(1000);

ser.println("AT+CIFSR");

delay(1000);

}

// Where the Magic Happens

void loop()

{

serialOutput();

if (QS == true) // A Heartbeat Was Found

{

fadeRate = 255; // Makes the LED Fade Effect Happen, Set 'fadeRate' Variable to 255 to fade LED with pulse

serialOutputWhenBeatHappens(); // A Beat Happened, Output that to serial.

QS = false; // reset the Quantified Self flag for next time

}

ledFadeToBeat(); // Makes the LED Fade Effect Happen

delay(20); // take a break

read\_temp();

esp\_8266();

}

void ledFadeToBeat()

{

fadeRate -= 15; // set LED fade value

fadeRate = constrain(fadeRate,0,255); // keep LED fade value from going into negative numbers!

analogWrite(fadePin,fadeRate); // fade LED

}

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 Happened \*\*\* "); //ASCII Art Madness

Serial.print("BPM: ");

Serial.print(BPM);

Serial.print(", Temperature: ");

Serial.print(temp);

Serial.println(" F");

}

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:

switch (range)

{

case 0:

Serial.println(""); /////ASCII Art Madness

break;

case 1:

Serial.println("---");

break;

case 2:

Serial.println("------");

break;

case 3:

Serial.println("---------");

break;

case 4:

Serial.println("------------");

break;

case 5:

Serial.println("--------------|-");

break;

case 6:

Serial.println("--------------|---");

break;

case 7:

Serial.println("--------------|-------");

break;

case 8:

Serial.println("--------------|----------");

break;

case 9:

Serial.println("--------------|----------------");

break;

case 10:

Serial.println("--------------|-------------------");

break;

case 11:

Serial.println("--------------|-----------------------");

break;

}

}

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)-130; // 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

pulse = BPM;

}

}

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!

}

void esp\_8266()

{

// TCP connection AT+CIPSTART=4,"TCP","184.106.153.149",80

String cmd = "AT+CIPSTART=4,\"TCP\",\"";

cmd += "184.106.153.149"; // api.thingspeak.com

cmd += "\",80";

ser.println(cmd);

Serial.println(cmd);

if(ser.find("Error"))

{

Serial.println("AT+CIPSTART error");

return;

}

String getStr = "GET /update?api\_key=";

getStr += apiKey;

getStr +="&field1=";

getStr +=String(temp);

getStr +="&field2=";

getStr +=String(pulse);

getStr += "\r\n\r\n";

// send data length

cmd = "AT+CIPSEND=4,";

cmd += String(getStr.length());

ser.println(cmd);

Serial.println(cmd);

delay(1000);

ser.print(getStr);

Serial.println(getStr); //thingspeak needs 15 sec delay between updates

delay(3000);

}

void read\_temp()

{

int temp\_val = analogRead(A1);

float mv = (temp\_val/1024.0)\*5000;

float cel = mv/10;

temp = (cel\*9)/5 + 32;

Serial.print("Temperature:");

Serial.println(temp);

lcd.clear();

lcd.setCursor(0,0);

lcd.print("BPM :");

lcd.setCursor(7,0);

lcd.print(BPM);

lcd.setCursor(0,1);

lcd.print("Temp.:");

lcd.setCursor(7,1);

lcd.print(temp);

lcd.setCursor(13,1);

lcd.print("F");

}