IoMT: Detection of Post-Traumatic Stress Disorder Episodes based on Arduino Technology

Jianxiao Cai, Dr. Laavanya Rachakonda
Shanghai Normal University, University of North Carolina Wilmington

Abstract

Posttraumatic stress disorder (PTSD) is a psychiatric disorder that may occur in people who have experienced or witnessed a traumatic event, series of events, or set of circumstances.[1]

Arduino UNO board contains a microcontroller that is able to be programmed to sense and control objects in the physical world. By responding to sensors and inputs, the Arduino board is able to interact with an extensive array of outputs.[2]

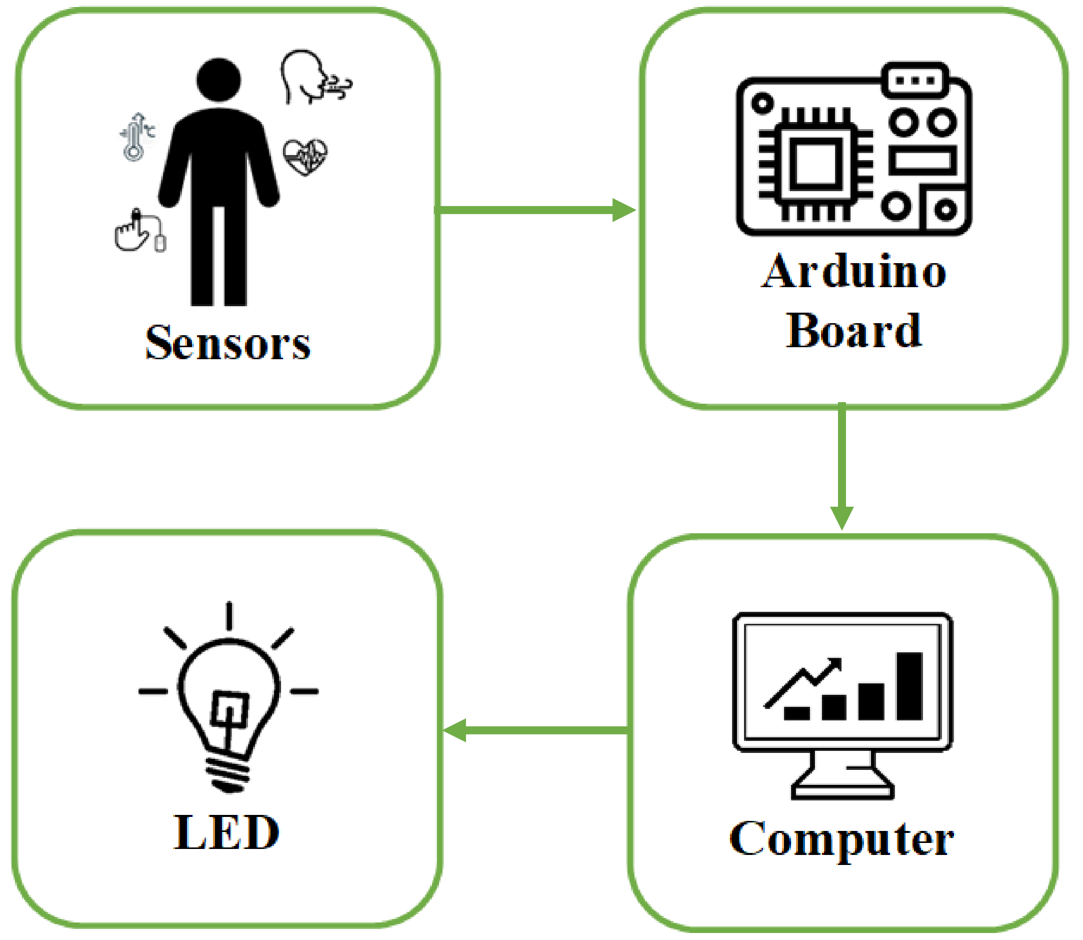
ThingSpeak is an IoT analytics platform service that allows you to aggregate, visualize, and analyze live data streams in the cloud. You can send data to ThingSpeak from your devices, create instant visualization of live data, and send alerts.

Detecting changes in the body's indicators during a PTSD episode can help us understand more about PTSD as a mental illness, which in turn can help us know how to prevent and treat PTSD.

Main Objective

Various indicators of the body change during an episode of PTSD. PTSD episodes can be detected by utilizing sensors to transmit relevant data to the Arduino and monitoring it through the serial port.

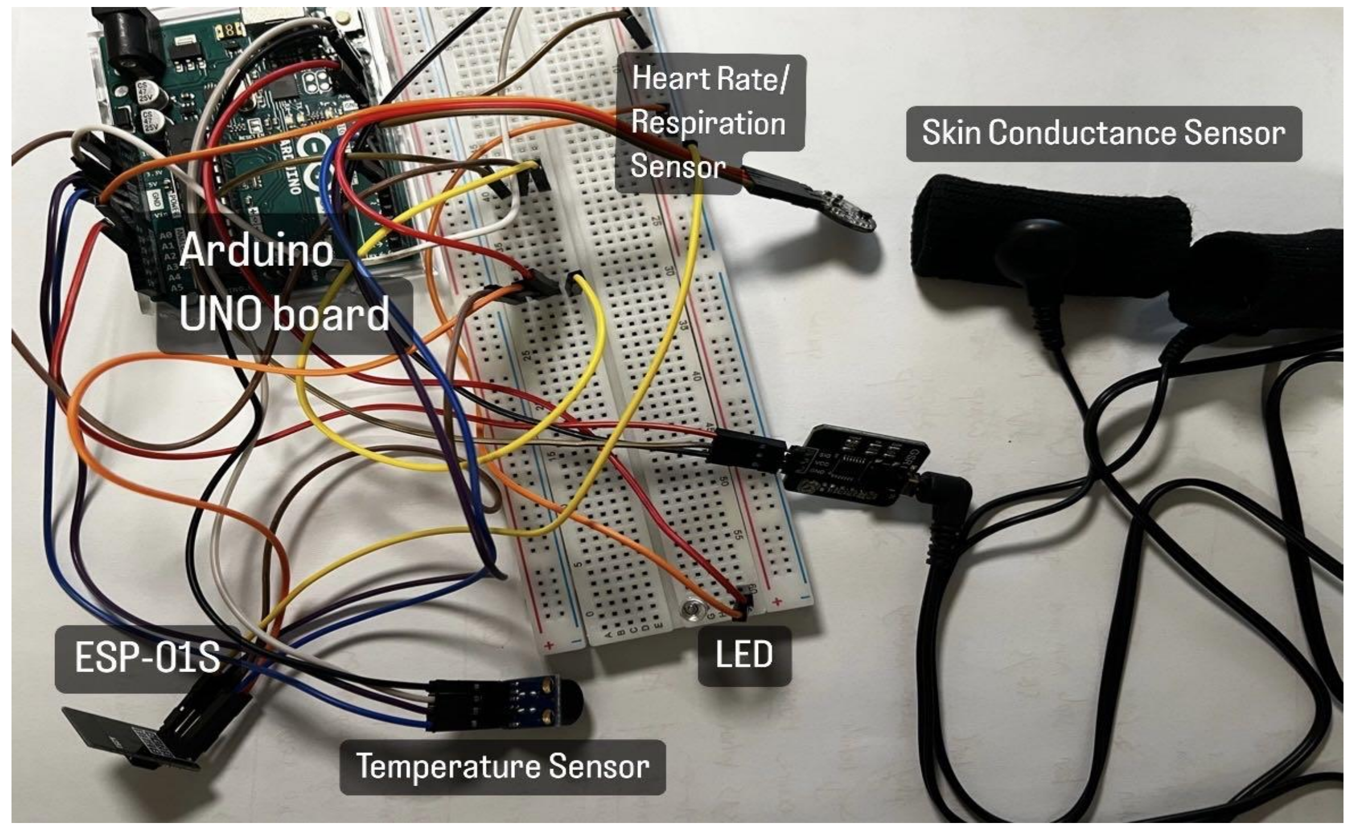
On the hardware side, we can indicate the urgency of the attack with the blinking frequency of the LEDs, while utilizing IoT technology to indicate it via WIFI on the ThingSpeak platform.



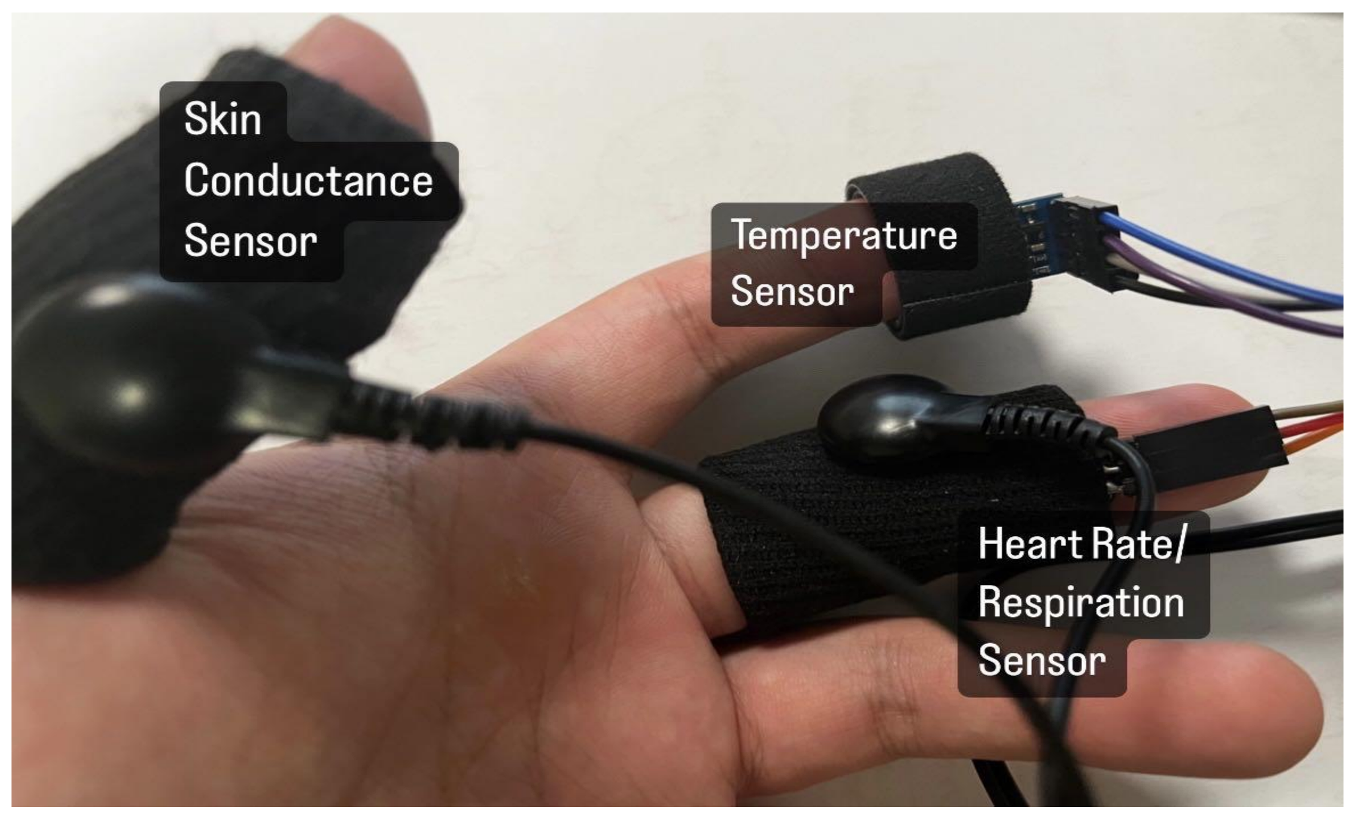
Parameter Analyses[3][4][5]

Sensor	Temperature (°C)	Skin Conductance Level (μS)	Heart Rate (bpm)	Respiration Rate(bpm)
PTSD Not Attacks	36.1-37.5	3.1-3.9	61-120	12-15
PTSD Attacks	37.5-41.0	4.0-5.8	57-191	16-20

Hardware



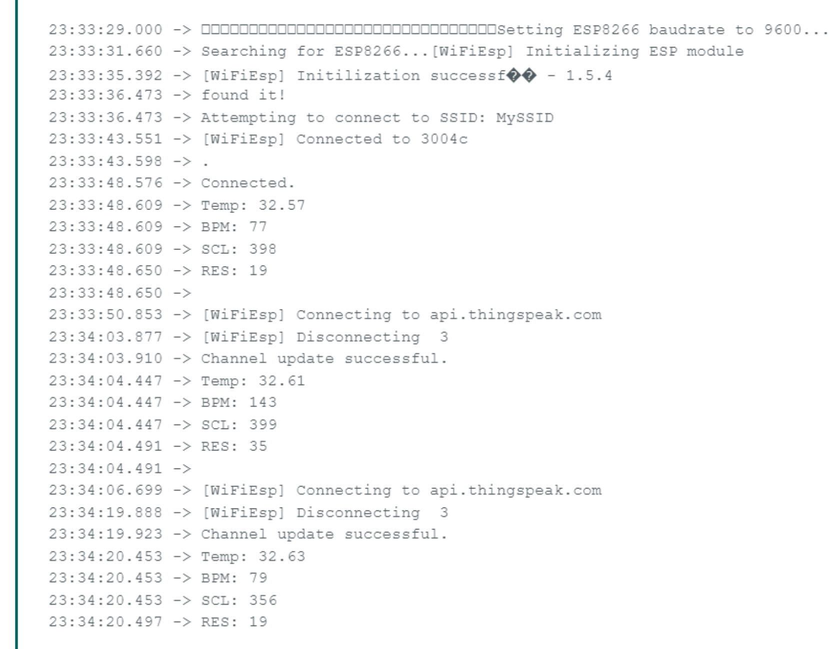
Equipment

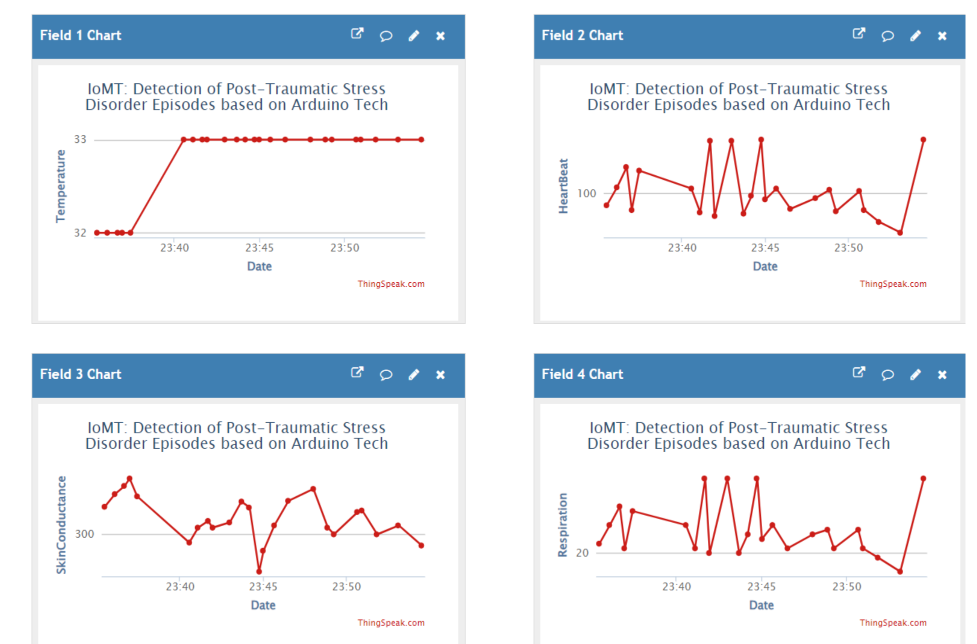


Code (Excerpt)

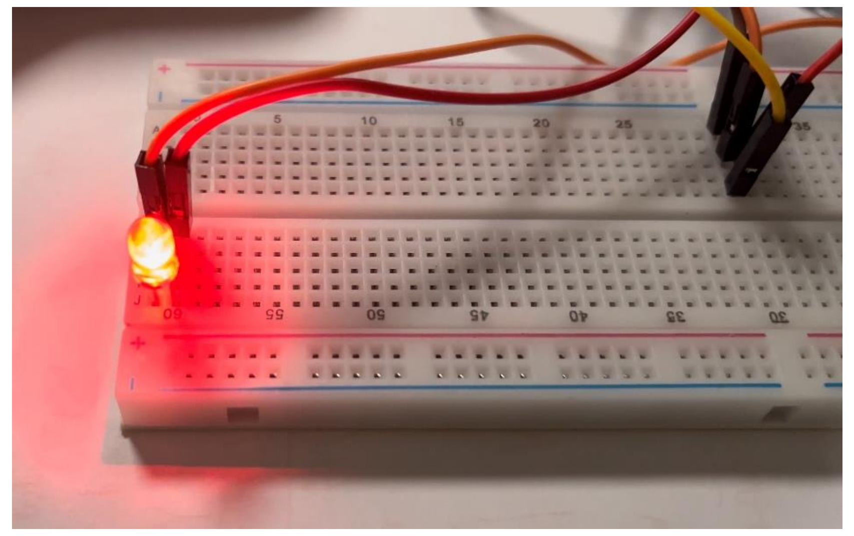
```
#include <Wire.h>
#include <Adafruit_MLX90614.h>
#define USE_ARDUINO_INTERRUPTS true
#include <PulseSensorPlayground.h>
#include "WiFiEsp.h"
#include "secrets.h"
#include "ThingSpeak.h" // always include thingspeak

Adafruit_MLX90614 mlx = Adafruit_MLX90614();

void setup() {
  //Initialize serial and wait for port to open
  Serial.begin(9600);  // Initialize serial

  while(!Serial){
    ; // wait for serial port to connect. Needed for L
  }

  // initialize serial for ESP module
  setEspBaudRate(ESP_BAUDRATE);

  while (!Serial) {
    ; // wait for serial port to connect. Needed for L
  }

  Serial.print("Searching for ESP8266...");
  // initialize ESP module
  WiFi.init(&Serial1);

  // check for the presence of the shield
  if (WiFi.status() == WL_NO_SHIELD) {
    Serial.println("WiFi shield not present");
    // don't continue
    while (true);
  }
  Serial.println("found it!");

  ThingSpeak.begin(client);  // Initialize ThingSpeak

    // set the fields with the values
    int temperature=(mlx.readAmbientTempC());
    ThingSpeak.setField(1, temperature);
    int myBPM = analogRead(PulseSensorpin)/4;
    ThingSpeak.setField(2, myBPM);
    sensorValue=analogRead(GSR);
    ThingSpeak.setField(3, sensorValue);
    int resp=myBPM/4;
    ThingSpeak.setField(4, resp);

      Serial.print("Temp: ");
      Serial.print(mlx.readAmbientTempC());
      Serial.println();
      Serial.print("BPM: ");
      Serial.println(myBPM);
      Serial.print("SCL: ");
      Serial.println(sensorValue);
      Serial.print("RES: ");
      Serial.println(resp);
      Serial.println();

    if(sum==2)
    {
      digitalWrite(LED,HIGH);
      delay(1000);
      digitalWrite(LED,LOW);
      delay(3000);
    }
    else if(sum==3)
    {
      digitalWrite(LED,HIGH);
      delay(200);
      digitalWrite(LED,LOW);
```

Outcomings





```
created_at,entry_id,field1,field2,field3,field4
2023-08-15 15:35:28 UTC,1,32,90,337,22
2023-08-15 15:36:05 UTC,2,32,105,354,26
2023-08-15 15:36:40 UTC,3,32,122,365,30
2023-08-15 15:36:58 UTC,4,32,86,375,21
2023-08-15 15:37:25 UTC,5,32,119,351,29
2023-08-15 15:40:33 UTC,6,33,104,289,26
2023-08-15 15:41:05 UTC,7,33,84,309,21
2023-08-15 15:41:41 UTC,8,33,144,318,36
2023-08-15 15:41:57 UTC,9,33,81,309,20
2023-08-15 15:42:41 UTC,10,33,84,337,21
2023-08-15 15:42:59 UTC,11,33,144,316,36
2023-08-15 15:43:41 UTC,12,33,83,344,20
2023-08-15 15:44:11 UTC,13,33,98,336,24
2023-08-15 15:44:45 UTC,14,33,145,250,36
```



We see the output data from the Serial Monitor, as well as the graphs on the ThingSpeak platform. By downloading the data, we can analyze the characteristics of the onset of PTSD. At the same time, the blinking LEDs can help us understand the emergency of the patient's PTSD episode.

References

[1] "Wayback Machine," Apr. 03, 2018. https://web.archive.org/web/20180403132515/http://www.princeton.edu/~ffab/media___downloads_files/IntroArduinoBook.pdf (accessed Aug. 16, 2023).

[2] M. Sadeghi, F. Sasangohar, A. Mcdonald, and S. Hegde, "Understanding Heart Rate Reactions to Post-Traumatic Stress Disorder (PTSD) Among Veterans: A Naturalistic Study," Human Factors: The Journal of the Human Factors and Ergonomics Society, vol. 64, p. 001872082110340, Jul. 2021, doi: 10.1177/00187208211034024.

[3] T. Oka, "Psychogenic fever: how psychological stress affects body temperature in the clinical population," Temperature (Austin), vol. 2, no. 3, pp. 368–378, Jun. 2015, doi: 10.1080/23328940.2015.1056907.

[4] R. Hinrichs et al., "Mobile assessment of heightened skin conductance in posttraumatic stress disorder," Depression and Anxiety, vol. 34, no. 6, pp. 502–507, 2017, doi: 10.1002/da.22610.

[5] "(PDF) Understanding Heart Rate Reactions to Post-Traumatic Stress Disorder (PTSD) Among Veterans: A Naturalistic Study." https://www.researchgate.net/publication/353396891_Understanding_Heart_Rate_Reactions_to_Post-Traumatic_Stress_Disorder_PTSD_Among_Veterans_A_Naturalistic_Study (accessed Aug. 16, 2023).

ThingSpeak: https://thingspeak.com/channels/2228162