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

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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] **A**rduino 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] **T**hingSpeak 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.
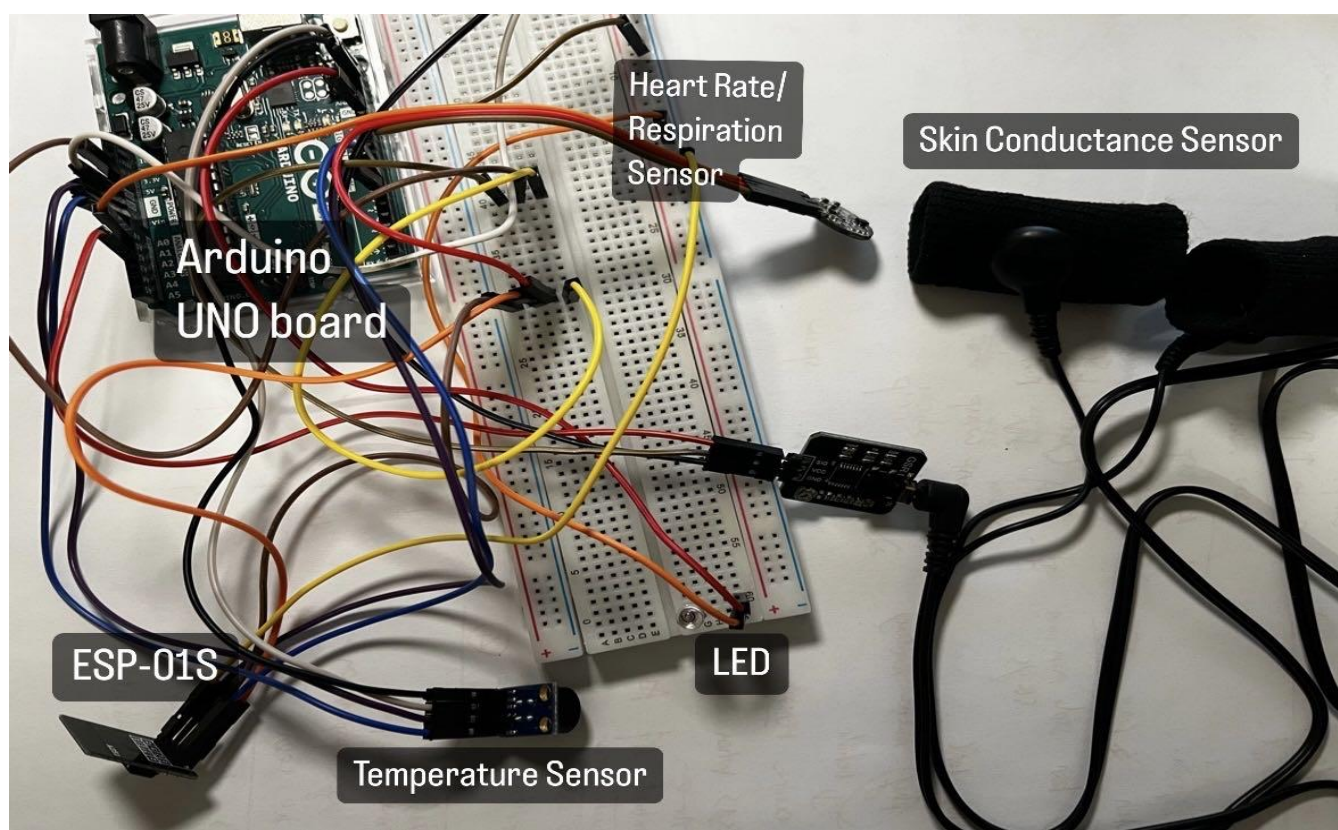
Main Objective

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.
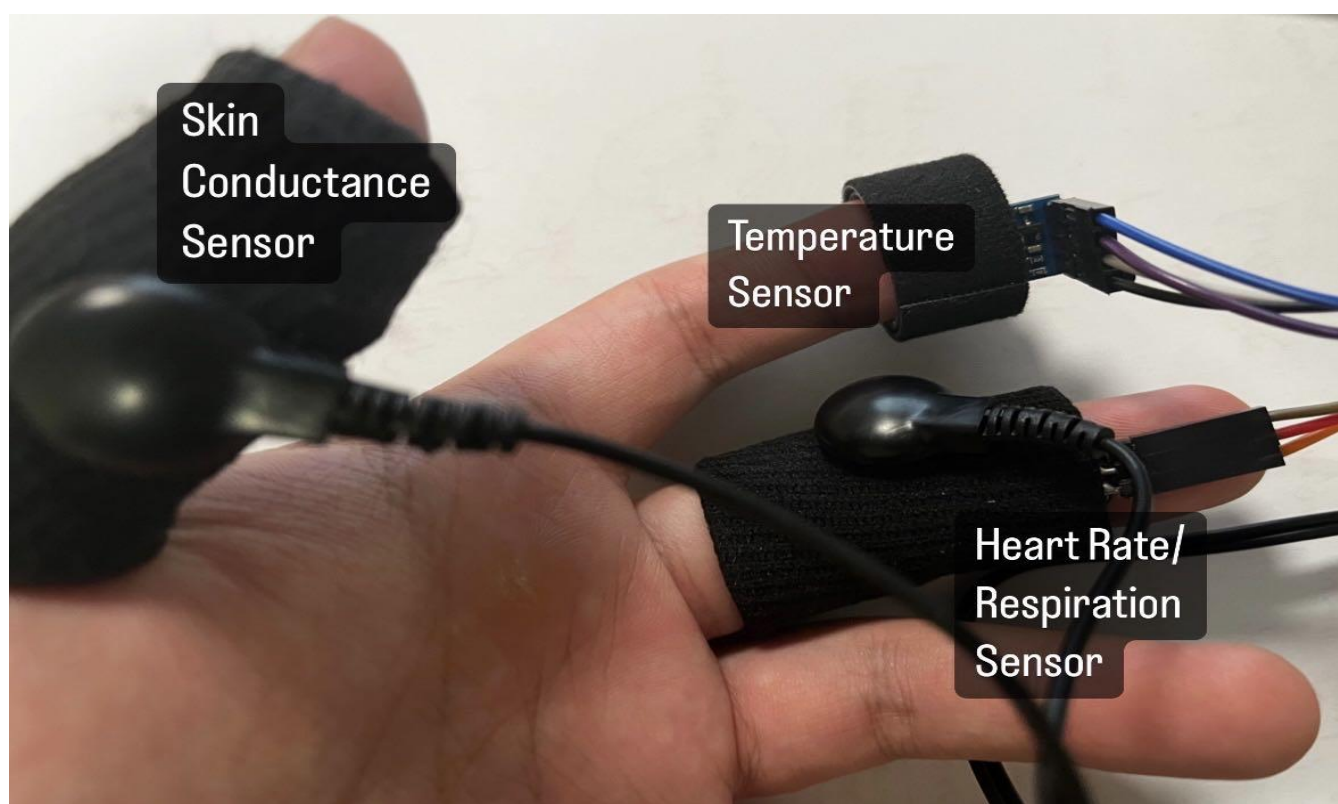

Parameter Analyses[3][4][5]

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

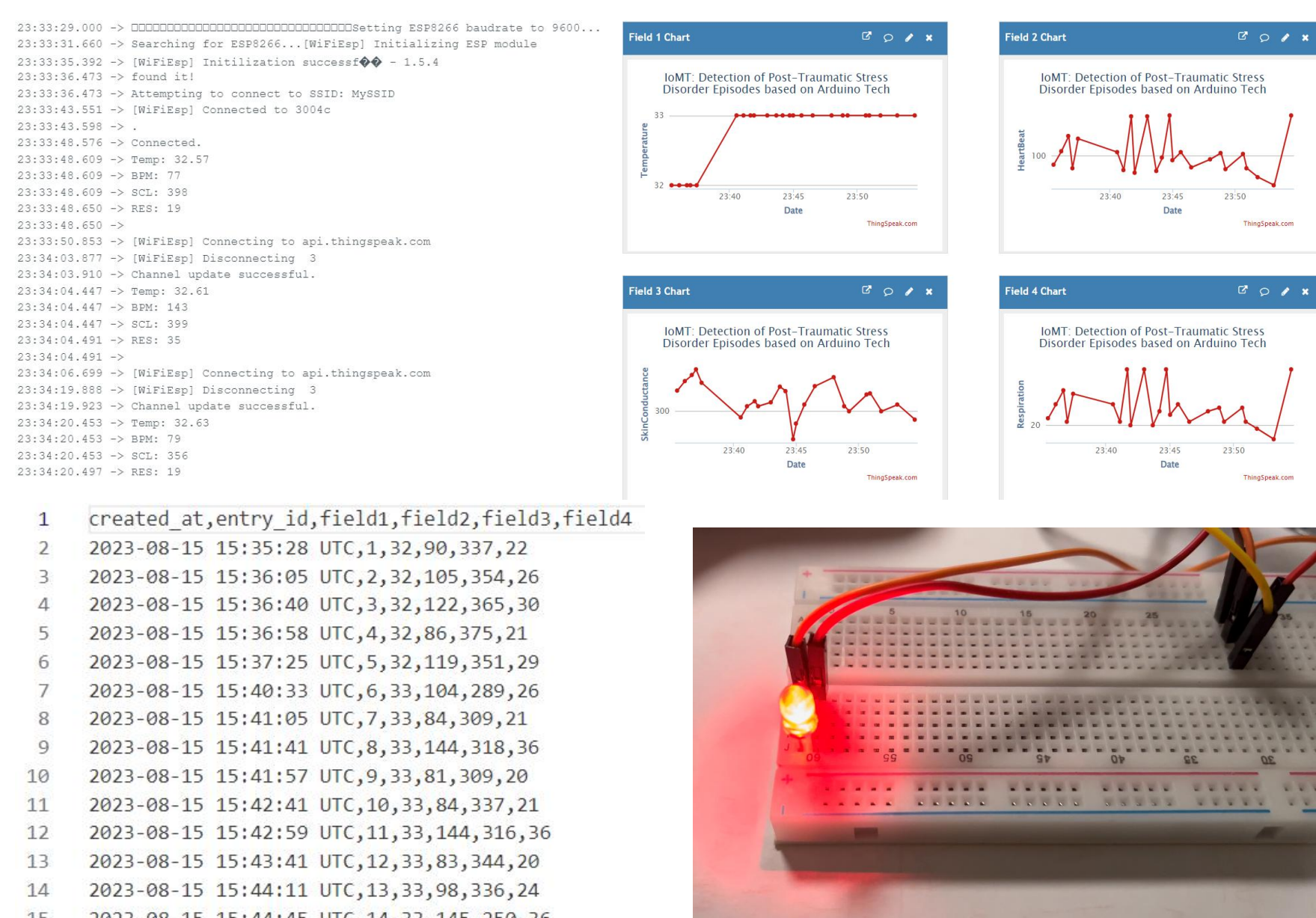## Code (Excerpt)

```
1   #include <Wire.h>
2   #include <Adafruit_MLX90614.h>
3   #define USE_ARDUINO_INTERRUPTS true
4   #include <PulseSensorPlayground.h>
5   #include "WiFiEsp.h"
6   #include "secrets.h"
7   #include "ThingSpeak.h" // always include thingspeak
8
9   Adafruit_MLX90614 mlx = Adafruit_MLX90614();

44  void setup() {
45    //Initialize serial and wait for port to open:
46    Serial.begin(9600);  // Initialize serial
47
48    while(!Serial){
49      ; // wait for serial port to connect. Needed for L
50    }
51
52    // initialize serial for ESP module
53    setEspBaudRate(ESP_BAUDRATE);
54
55    while (!Serial) {
56      ; // wait for serial port to connect. Needed for L
57    }
58
59    Serial.print("Searching for ESP8266...");
60    // initialize ESP module
61    WiFi.init(&Serial1);
62
63    // check for the presence of the shield
64    if (WiFi.status() == WL_NO_SHIELD) {
65      Serial.println("WiFi shield not present");
66      // don't continue
67      while (true);
68    }
69    Serial.println("found it!");
70
71    ThingSpeak.begin(client);  // Initialize ThingSpeak

95    // set the fields with the values
96    int temperature=(mlx.readAmbientTempC());
97    ThingSpeak.setField(1, temperature);
98    int myBPM = analogRead(PulseSensorpin)/4;
99    ThingSpeak.setField(2, myBPM);
100   sensorValue=analogRead(GSR);
101   ThingSpeak.setField(3, sensorValue);
102   int resp=myBPM/4;
103   ThingSpeak.setField(4, resp);
104
105   Serial.print("Temp: ");
106   Serial.print(mlx.readAmbientTempC());
107   Serial.println();
108   Serial.print("BPM: ");
109   Serial.println(myBPM);
110   Serial.print("SCL: ");
111   Serial.println(sensorValue);
112   Serial.print("RES: ");
113   Serial.println(resp);
114   Serial.println();

122   if(sum==2)
123   {
124     digitalWrite(LED,HIGH);
125     delay(1000);
126     digitalWrite(LED,LOW);
127     delay(3000);
128   }
129   else if(sum==3)
130   {
131     digitalWrite(LED,HIGH);
132     delay(200);
133     digitalWrite(LED,LOW);
```

Outcomings


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