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Mental Abuse Detection System Based on IoT

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Abstract: The challenges and pressures of modern life confront the younger generation until those who compete, putting them at risk of mental illness. Due to society's unawareness that emotional abuse leaves deeper and could not be seen by the public eyes. Thus, this work is a system that can detect mental abuse specifically for youth. By referencing to symptoms of body temperature, heart rate, and oxygen saturation. By focusing on youth from 18 years old to 29 years old. The development of the system used of body temperature, oxygen saturation, and heart rate sensors to track the signs of an abnormal person using selected hardware and software of Node MCU ESP8266, MAX30100, MLX90614, Arduino IDE, and Blynk Application. This study shows that mental abuse can be detected by using the develop system with 98% of discrepancy and youth who are subjected to mental abuse can then be identified. Improving on GPS gives more accurate location and better monitoring the location of latitude and longitude in every second.

Keywords: Mental Abuse, MLX90614 Sensor, Arduino IDE, Blynk

1. Introduction

In today's increasingly fast-paced world, the challenges confronting the younger generation are vastly different from those faced by the previous generation. The pressure that youth face occasionally begins with comparing themselves to their peers and their flaws [1]. It also occurs when fail to meet objectives. In this context, abuse can be classified into several types and one of them is mental abuse. Mental abuse is a silent catastrophe. According to Health Psychology Research, there was an increase in reported suicide cases in 2020, with 631 cases compared to 609 cases in 2019. Some people are predisposed to mental health problems, including depression, when under extreme stress and isolated from support network of family and friends. Then decided on suicide due to severe depression.

Mental abuse is a severe form of abuse that can occur before, during, or after any other type of abuse. Mental abuse is never the fault of the person subjected to it [2]. The youth may experience sleep disorders, muscle tension, fatigue, shortness of breath, trembling and clammy hands. Thus, it called as anxiety. One of the most typical signs of emotional abuse is anxiety and shows different symptoms in

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youth [3]. Therefore, the provision of several hardware was used to detect the probability of symptoms such as oxygen level, body temperature and shortness of breath experienced by youth.

Table 1 shows the various symptoms of mental abuse. The system can identify aberrant body temperatures, heart rates, and oxygen levels in youth between the ages of 18 and 29 [4]. The symptoms of mental abuse can be used to assess the severity of the abuse [5]. This work has concentrated on two main cases using this classification. Cases of mild mental abuse will be classified as mild level one, while critical cases will be classified as levels two.

Table 1: The classification symptoms of mental abuse [5]

Item	Symptoms		
	Heartbeat rate	Oxygen saturation	Body temperature
1	≥60-100bpm	≥95%	36-37℃
2	≥100bpm	≤95%	≤36℃

Internet of Things (IoT) represents the next step towards the smart devices that used to connect between things and people. We describe an IoT-based smart monitoring heartbeat rate for detect mental abuse among youth 18 years to 29 years old. This application should include good monitoring, and notified parents or caregivers to improve the safety and dependable.

2. Methodology

This section explains the block diagram of this work. It also describes the flowchart of development and design of the system utilizing selected hardware and software.

2.1 Block diagram of the proposed system

Figure 1 shows the block diagram of the proposed system. The system uses some hardware equipment namely, ESP8266 as the microcontroller, MAX30100 as the Heartbeat Rate and Oxygen Saturation Sensor, MLX9014 used to measured human body temperature and Blynk as the Cloud Application Server [6].

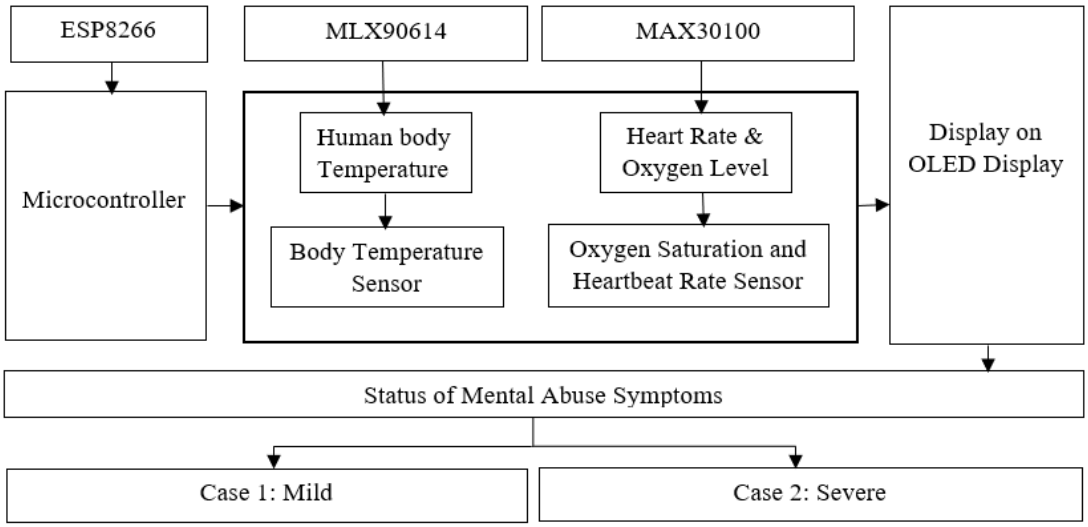

Figure 1: The block diagram of the proposed system

At first, the coding from Arduino IDE will store in the microcontroller. The system should initialize mental care and measure the heartbeat, oxygen levels and body temperature of the youth. Then, the system will then continue to monitor from both sensor MLX90614 and MAX30100. All the

measurement will display on OLED display. Finally, the measurement matched with mental abuse condition and parents or caregivers will be notified [7].

2.2 Flowchart of the system

The flowchart of the system as shown in Figure 2. The system comprises of Spo2, heart rate and body temperature sensor. There are two condition of mental abuse which are mild and severe. The mild heart rate is in between 60-100bpm with Spo2 is greater than 95% and body temperature is in between 36-37℃ [8]. These symptoms are declared in Case 1. If it is does not detected for severe symptoms which are heart rate ≥100bpm with Spo2 lower than 95% and body temperature is below than 36℃. Notification will be sends to parents or caregivers. Otherwise, the sensor of heart rate, oxygen saturation and body temperature being continuously monitored.

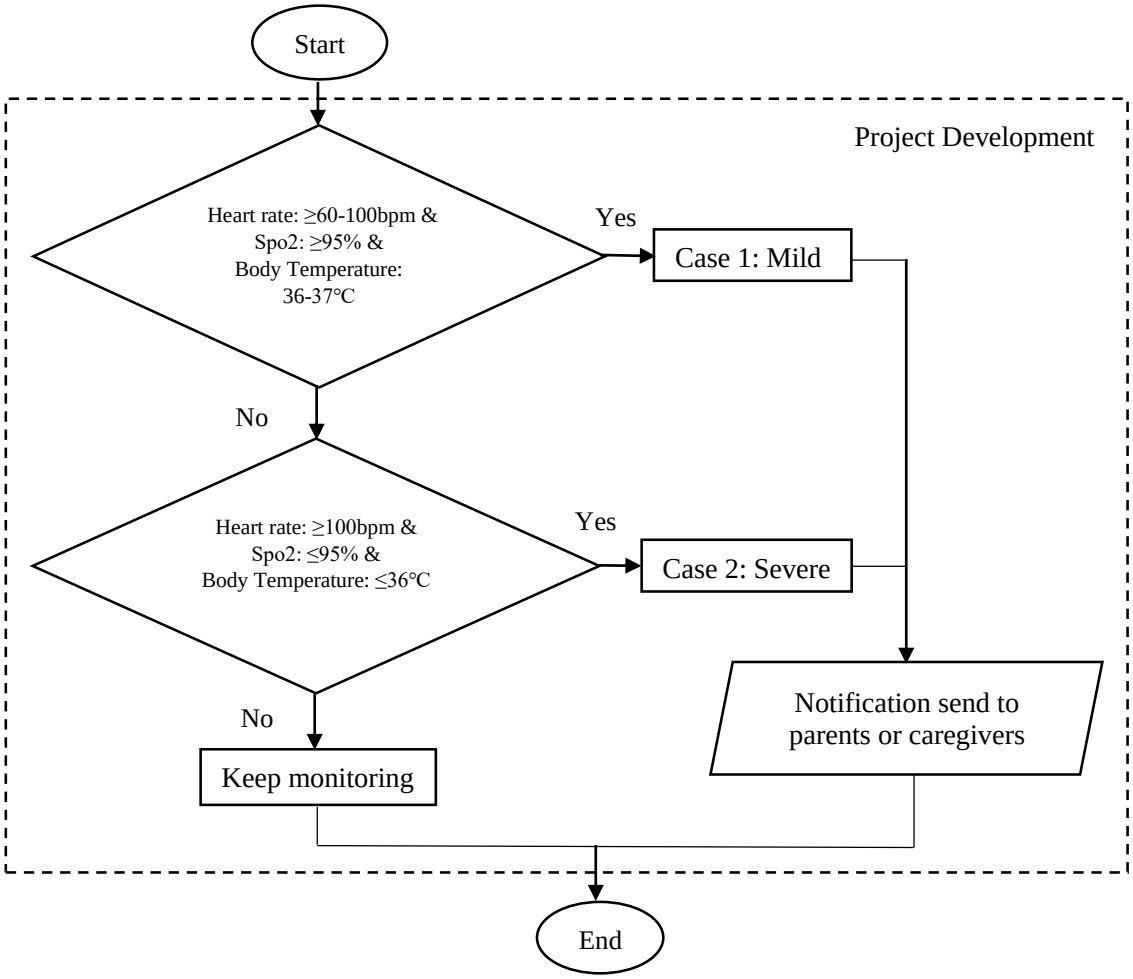

Figure 2: The flowchart of the system

2.3 Hardware Connection of Proposed System

Based on the research that has been done, the proposed outcome of this system is both the MAX30100 module and the MLX90614 can continuously generate heartbeat rate, oxygen saturation, and body temperature with proper connection and coding throughout the Arduino IDE [9].

Figure 3 shows all the hardware connections and its setup as well. Once the system is turned on to power supply, both sensors will be on. The force applied when two fingers are pressed against the heartbeat rate and oxygen level sensor MAX30100 and another sensor MLX60914. These two sensors can be perused (ESP 8266). Then, measurement will be displayed on an OLED display. D1 and D2

from the microcontroller are used to connect to the other sensors. All the connection start with more than 20 jumper male to male 30cm. Each of the connection comes with SDA, SCL, VCC, and Ground. And since I2C is a serial communication protocol that connects and controls multiple slaves from a single device, the connection can read the measurement.

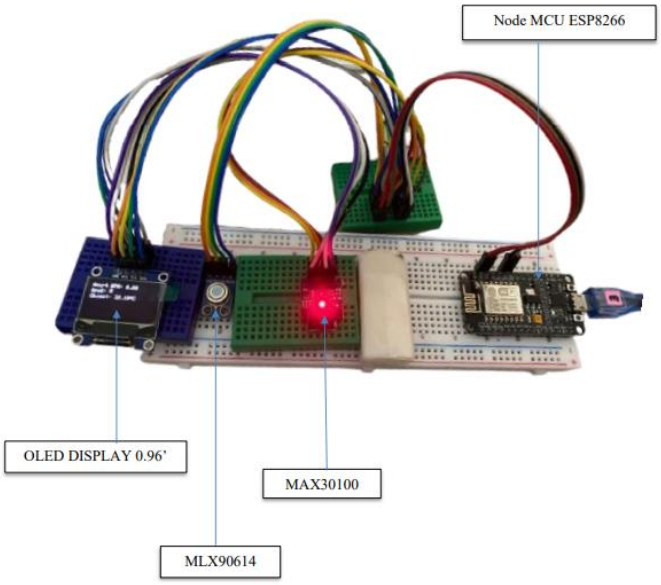

Figure 3: Hardware connection of proposed system

2.4 Circuit Design and Final Prototype

The circuit design of the system with prototype is shows in Figure 4. The model is based on a simple of extension casing that allows students to easily plug in the USB wire to connect to the power source. The front of the case can be opened and installed easily.

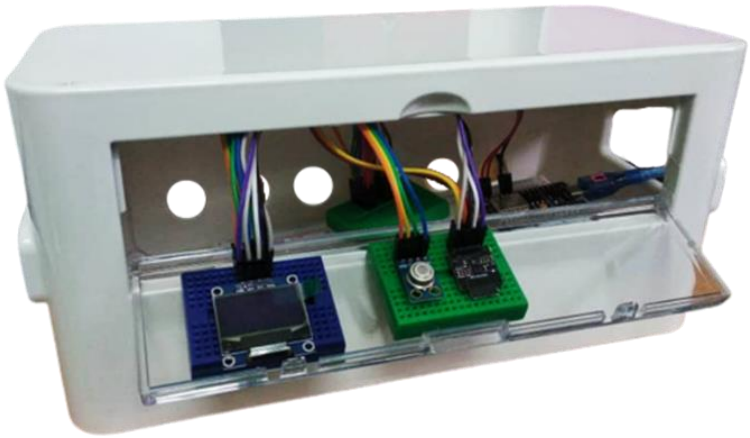

Figure 4: Circuit design and final prototype

2.5 Experiment Protocol

Shows the way of measurement conducted for both MAX30100 and MLX90614 sensors. Person with mental abuse is simulated by running, and jumping to increase heart rate. Furthermore, frozen jelly is used to represent lower temperature of human body to get severe cases.

2.5.1 System Measurement

The system is designed to continuously measure under moderate pressure only. If none of case display on the OLED indicates that the measurement does not match the system parameter.

Since, case 1 is a normal or mild case, both index finger and middle finger should be placed to MAX30100 and MLX90614 sensor as shown in Figure 5. A person needs to be in a calm, and relax mode whether sitting or standing. The measurement will be unbalanced if the pressure is applied too strongly, and vice versa. The OLED will display the actual range if it recaptures in the same range within 8 seconds.

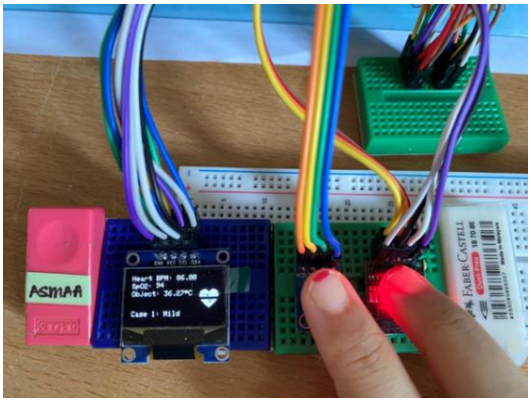

Figure 5: The measurement for Case 1

Figure 6 shows a person touching the frozen jelly with both thumb and index finger. In the same situation, makes a simple step run in 20 seconds. Before the index finger is placed on the MLX90614 sensor while the middle finger approaches the MAX30100 sensor, the frozen jelly was placed away from the temperature sensor. The measurement is measured on OLED display. Based on two tests conducted, this system has successfully measured and detected the level of severe cases with the heartbeat rate of 173.57bpm and the body temperature of 36.83℃.

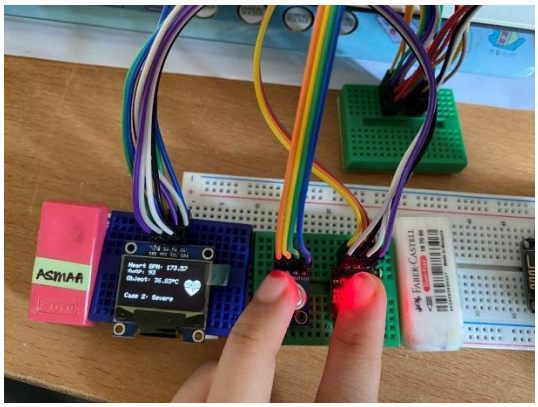

Figure 6: The measurement for Case 2

2.6 Sensor Reading Discrepancy

At each measurement, calculations are required to determine the success of the system. This measurement study was processed and divided into heartbeat rate and oxygen level in youth. Both devices are used to facilitate the work for determining the relative of errors in this system. Fingertip pulse oximeter is used to measure actual heartbeat rate and oxygen level. Meanwhile, the GP-300 Infrared Gun Thermometer acts to measure the actual temperature of the human body. Furthermore, measurement reading is based on the result that measured by MAX30100 and MLX90614 for measurement reading of heart rate with Spo2 level and body temperature, accordingly.

3. Results and Discussion

This testing is conducted to calculate the mean error and evaluate the accuracy between this system and the existing equipment. Among the sensors involved are MAX30100 and MLX90614. The fingertip pulse oximeter can measure both the oxygen saturation and heartbeat rate. Meanwhile, the temperature of the human body is measured using an Infrared body temperature sensor.

3.1 Result of discrepancy testing

Table 2 shows the reading of the discrepancy testing each of the hardware, at the beginning the oxygen level is 0.03 which are remained constant. The reading starts slightly dropped and reached back 0.03 until half of the reading. This reading is seen to fluctuate continuously until it reaches the last reading. Next, in heartbeat rate discrepancy, there is a plunged reading from 0.06 to 0.01 and reached a least discrepancy on 5th reading. However, on 18th heartbeat rate discrepancy reading was judged to have 0.03 discrepancy compared to the oxygen saturation and body temperature reading. In the body temperature discrepancy, seen as not declared to have much difference, where each is less than 0.01, 0.02 and 0.00 respectively. The 6th reading shows the most difference reading with 0.01 compared to the discrepancy of oxygen level and discrepancy of heartbeat rate.

Table 2: The discrepancy testing each of the hardware

Symptoms	Oxygen Level			Heartbeat rate			Body Temperature		
Devices	Measurement	Actual	Relative Error	Measurement	Actual	Relative Error	Measurement	Actual	Relative Error
	MAX30100 (%)	Fingertip Pulse Oximeter	Oxygen level discrepancy	MAX30100 BPM	Fingertip Pulse Oximeter	Heartbeat rate discrepancy	MLX90614 ℃	GP-300 Infrared Gun Thermometer ℃	Body temperature discrepancy
1	98.00	95.00	0.03	88.00	83.00	0.06	36.80	36.60	0.01
2	98.00	95.00	0.03	83.00	78.00	0.06	36.80	36.70	0.00
3	97.00	94.00	0.03	85.00	86.00	0.01	36.80	36.60	0.01
4	98.00	95.00	0.03	78.00	75.00	0.04	36.70	36.40	0.01
5	97.00	94.00	0.03	84.00	77.00	0.09	36.80	36.60	0.01
6	98.00	96.00	0.02	87.00	85.00	0.02	35.80	36.10	0.01
7	96.00	95.00	0.01	68.00	65.00	0.05	36.80	36.50	0.01
8	98.00	95.00	0.03	81.00	76.00	0.07	36.60	36.60	0.00
9	99.00	96.00	0.03	89.00	86.00	0.03	36.40	36.50	0.00
10	98.00	95.00	0.03	69.00	67.00	0.03	36.60	36.10	0.01
11	95.00	95.00	0.00	96.00	97.00	0.01	36.70	36.10	0.02
12	98.00	96.00	0.02	85.00	87.00	0.02	36.50	36.50	0.00
13	98.00	95.00	0.03	80.00	77.00	0.04	36.60	36.10	0.01
14	97.00	95.00	0.02	85.00	86.00	0.01	36.50	36.20	0.01
15	98.00	96.00	0.02	83.00	80.00	0.04	36.80	36.70	0.00
16	99.00	97.00	0.02	69.00	67.00	0.03	36.20	36.30	0.00
17	96.00	98.00	0.02	85.00	87.00	0.02	36.50	36.10	0.01
18	95.00	97.00	0.02	73.00	75.00	0.03	36.80	36.40	0.01
19	96.00	95.00	0.01	68.00	65.00	0.05	36.60	36.20	0.01
20	97.00	94.00	0.03	87.00	85.00	0.02	36.60	36.60	0.00
Avg	97.30	95.40	0.02	81.15	79.20	0.03	36.60	36.40	0.01

Table 3 shows the mean error of Spo2 is 0.02 with a discrepancy of 2.0% and achieve 98% accuracy to the system. The discrepancy of heartbeat rate with 3.0% it shows that this system has 97% accuracy compared to actual device. Meanwhile, body temperature shows 99% accuracy compared to Infrared Gun Thermometer.

Table 3: The accuracy each of the hardware

Item	Hardware	Mean Error		Discrepancy	Accuracy
1	MAX30100	Spo2	0.02	2.0%	98%
		Heartbeat Rate	0.03	3.0%	97%
2	MLX90614	Body Temperature	0.01	1.0%	99%

Figure 7 shows the actual and measurement of oxygen level. The 1st actual and measurement reading are 95% and 98% which continuously discrepancy of 0.03. This scenario creates a contradiction that persists through the fifth reading. At 11th, both actual and measurement keep read the same value which there was no relative error or discrepancy happened.

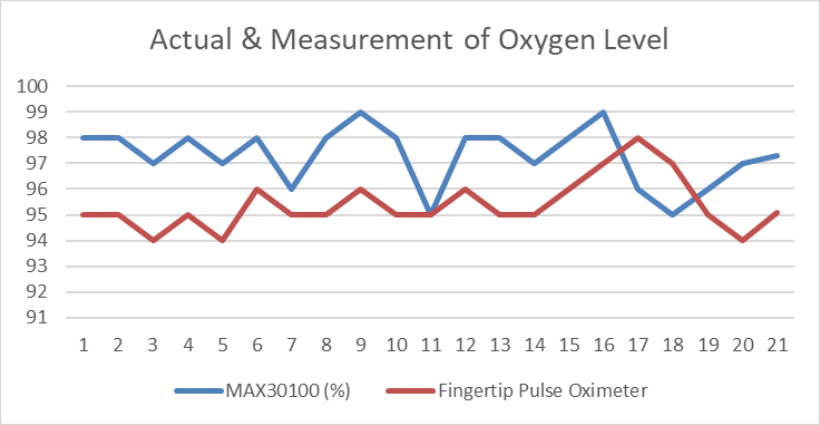

Figure 7: Actual and measurement of oxygen level

Figure 8 shows the actual and measurement of heartbeat rate. The 5th reading is seen to have significant differences. However, the 6th reading increased by 0.07 where the measurement was 87bpm and actual 85bpm respectively. The same difference can be seen in the 9th and 10th readings, which both have a difference of 0.03. The entire graph of measurement and actual reading by MAX30100 demonstrates fluctuation, with an actual average of 81.15bpm and a measured average of 79.2bpm.

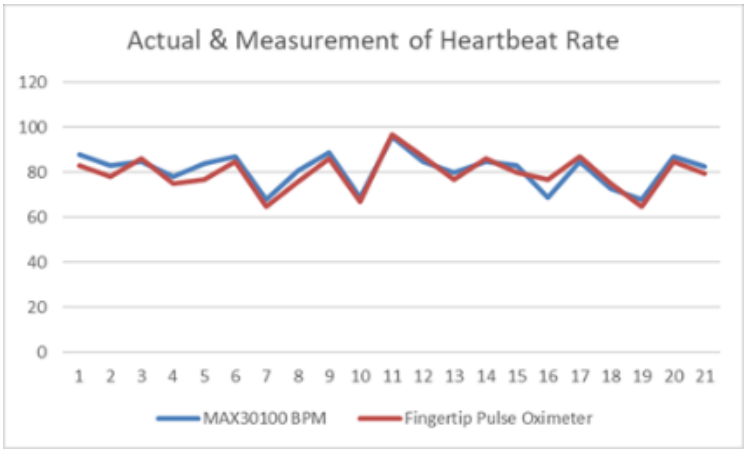

Figure 8: Actual and measurement of heartbeat rate

Figure 9 shows the actual and measurement of body temperature. There are minor differences when using the GP-300 Infrared Gun Thermometer and the MLX90614 sensor. As a result, the graphs for actual and measurement nearly have the same reading.

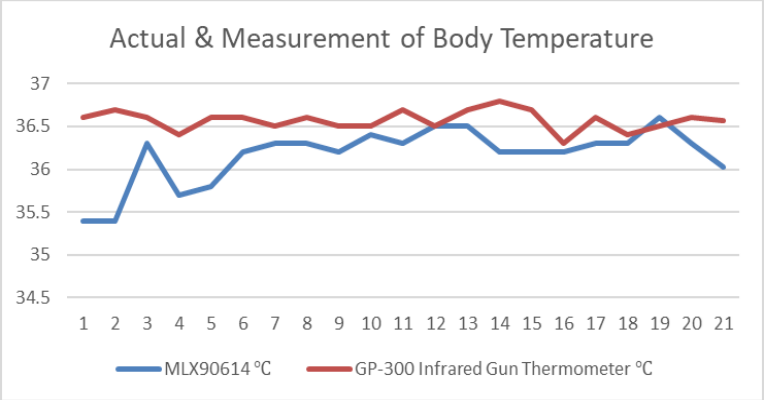

Figure 7: Actual and measurement of body temperature

3.2 Result in Blynk Application

Figure 8 shows in Blynk Application for case 1 shows the heart rate with 74.5bpm. The Spo2 95% and body temperature 37℃ are in between the system classified. As a result, the symptoms are in mild case. In Blynk Application shows the heart rate of 135.7 beats per minute is greater than 100bpm. A person running while touching frozen jelly in 20 seconds has a lower body temperature than a normal person, which is 29.2°C. As a result, the Blynk Application able send a notification to caretakers based on the symptoms trace.

Figure 8: Result in Blynk Application

3.3 Notification to Blynk Application

Figure 9 shows that guardians can receive notifications via Blynk notify [10]. The sensor data by "Blynk Alert" notification inform guardians to know how serious a mental abuse is.

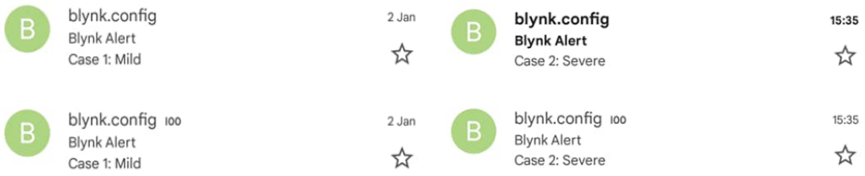

Figure 9: Notification to Blynk application

3.4 Discussions

The output for the serial monitors and Blynk Application, have been successfully gathered. The discrepancy of Spo2 is 2.0% which are lower than the discrepancy of heartbeat rate. Even though, heartbeat rate and Spo2 used the same device, but different accuracy. The MLX90614 sensor is the

sensor that has the closest reading value when compared to the Infrared Gun Thermometer GP-300 and achieves an accuracy of 99%. Overall, this system is acceptable for real economy use.

4. Conclusion

In conclusion, the new parameter used identifies the level of mental abuse. As a result, this system has 99% accuracy of body temperature compared to actual device. Another accuracy of oxygen level and heart rate is 98% and 97%, respectively. It is seen as a successful research to measure the level of mental abuse among youth. To achieve the entire goal, this system includes notifications as an additional Internet of Things (IoT) and then includes good monitoring to improve safety and dependability. The testing has been recorded and compared with the equipment in the market to convince the result designed for this system is correct and in according with the theory.

Acknowledgement

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