

Development of a Heart Rate Monitoring System

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Abstract

This project proposed by Dr. Pi-Sui Hsu of Northern Illinois University's College of Education entails the development of a heart rate monitoring device. This device is needed to determine the anxiety levels of STEM grade school students. By connecting a pulse sensor module to an Arduino board, a pulse waveform can be obtained. From that pulse waveform, a beats per minute (BPM) calculation is made and sent to an excel file for storage and later analysis.

Introduction

The students would wear the device during the STEM activities to allow observation of their anxiety levels. This would be helpful in knowing when to intervene to help the students when they feel anxious. There are similar devices currently on the market but unlike our device, they are too expensive and do not provide raw data that can be analyzed and recorded. Since the device is being used in a study, the data that was obtained was also compared against a medical device to ensure accuracy.

Methods and Materials

The pulse sensor pictured was connected to an Arduino board.

The sensor has a LED that calculates BPM by measuring the absorption of light. The sensor has noise eliminating circuitry built in which eliminates the need of a circuit. The built-in components allow for the overall size of the device to be small enough to wear.

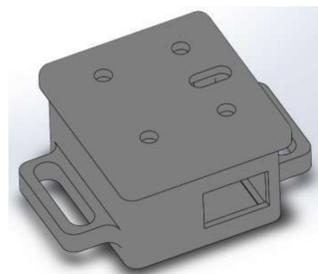


Fig. 1: 3D Model of Enclosure



Fig. 2: Pulse Sensor

Results

The image below shows an excel file containing the data that was obtained from a trial of the heart rate monitor device.

	A	B	C	D	E
1	Date	Time	BPM	IBI	raw data
2	4/16/2020	11:48:39 AM	78	1320	543
3	4/16/2020	11:49:09 AM	78	1320	555
4	4/16/2020	11:49:39 AM	78	1320	560
5	4/16/2020	11:50:09 AM	78	1320	553
6	4/16/2020	11:50:39 AM	78	1320	549
7	4/16/2020	11:51:09 AM	78	1320	545
8	4/16/2020	11:51:39 AM	78	1320	547
9	4/16/2020	11:52:09 AM	78	1320	515
10	4/16/2020	11:52:39 AM	78	1320	526
11	4/16/2020	11:53:09 AM	78	1320	525
12	4/16/2020	11:53:39 AM	78	1320	523
13	4/16/2020	11:54:09 AM	78	1320	496
14	4/16/2020	11:54:39 AM	78	1320	504
15	4/16/2020	11:55:09 AM	78	1320	529
16	4/16/2020	11:55:39 AM	78	1320	528
17	4/16/2020	11:56:09 AM	78	1320	518
18	4/16/2020	11:56:39 AM	78	1320	519
19	4/16/2020	11:57:09 AM	78	1320	523
20	4/16/2020	11:57:39 AM	78	1320	491
21	4/16/2020	11:58:09 AM	78	1320	496

Discussion

The average heart rate is 60-80 BPM. The higher the stress/anxiety level, the faster the heart beats. This logic can be applied to the data obtained from the heart rate monitor to determine how stressed the wearer of the device is.

Conclusions

For relatively half the price of a store-bought heart rate monitor, we developed a wearable device that successfully calculates and stores the BPM of the person wearing it. We have tested our device's functionality on adults so we can ensure it is safe for use on the children in the study. Ideally, the Arduino board could be replaced with a PCB to allow for manufacturing.

Acknowledgements

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