CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

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Project Number

S0832

Project Title

SmartRate: An Innovation in Early Detection, Warning, and Prevention of Cardiac Death

Abstract

Objectives/Goals

Within the United States alone, 326,000 people die each year due to cardiac arrest caused by underlying cardiac arrhythmias. Most or all these deaths would have been prevented if the Emergency Medical Services (EMS) had reached them within the necessary period of time, or they had prior knowledge of their fatal arrhythmia. We sought to solve both of these problems by creating a wearable heart rate analysis wristband that can automatically trigger notifications and warning upon a cardiac event, analyze user data for specific arrhythmias, minimize human error, and contact EMS faster (regardless of the user#s consciousness), saving the life of the user.

Methods/Materials

To make our prevention apparatus, we used an Atmel microcontroller coded using the C/C++ compiler in Arduino. The board was Adafruit based with Bluetooth configuration. The iOS application was made through Xcode using the Swift language. For heart rate, we used photoplethysmography, converting light reflection into signal values. After making the prototype, we tested various subjects ranging from 15-50 years old and both genders in comparison to modern wristbands, then chest electrodes, and finally to an electrocardiogram.

Results

Our device triggers a warning 100% of the time on all ages and genders with no false positives, due to mitigation procedures taken in algorithmic design. The device also had high correlation to hospital-level machines.

Conclusions/Discussion

Our device works efficiently and at a low cost to be able to save someone#s life, even without prior knowledge of the user#s cardiac health. We plan to manufacture the wristband in the future as well as add additional vital measurements through light reflection technology, such as blood pressure and oxygen saturation, both of which currently do not exist for portable technology. In addition, we plan on implementing this technology into hospitals, drastically reducing the size of the current monitors while retaining accuracy.

Summary Statement

We invented an innovative utilization for wrist-based heart rate analysis by developing our own wristband and iOS application using a novel notification algorithm, saving the life of the user by preempting cardiac arrest.

Help Received

No professional help was received. However, we received some guidance regarding fixing issues within our coding and algorithm order.