CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

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Project Number

S0829

Project Title

SmartRate: A Machine Learning Approach to Predicting Cardiac Arrest

Abstract

Objectives/Goals

The goal of this project is to prevent people afflicted by cardiac arrest from dying, individuals whose lives are significantly shortened every year simply because they did not arrive at the hospital in time. This is an issue that has been plaguing society since the advent of modern medicine, and yet is has not yet been solved- until now, with an inexpensive but functional wearable. The prototype features three distinct and effectual algorithms: one for the wristband itself- to calculate heart rate accurately regardless of movement, one for the iOS application- to recognize cardiac arrhythmias and autonomously notify EMS, and one for the remote server- developed with machine learning to predict cardiac events before they occur.

Methods/Materials

To develop the prevention apparatus, an Adafruit based Atmel microcontroller was utilized, coded with the C/C++ compiler in Arduino. The sensor features a photoplethysmographic module, converting reflected light into signal values to measure heart rate. The iOS application was written in Xcode using the Swift language, and the server was coded in Python and hosted remotely via Django. It was tested with a dynamic and local database containing 300 electrocardiogram samples from MIT, deployed on the server.

Results

This project has proved incredibly accurate- the wristband has 98.5% accuracy compared to a 12-lead electrocardiogram, the application recognizes the abnormal heart rate and notifies EMS 100% of the time, and the innovative machine learning predictive algorithm has an accuracy of 90-95%.

Conclusions/Discussion

The cumulative device, which is a combination of three distinct and effective algorithms integrated within an inexpensive wearable that communicates via Bluetooth with an iPhone, creates the possibility of reducing excess funding within hospitals and diminishing diagnosis time for arrhythmias from days to seconds, thereby drastically decreasing Emergency Medical Service time from hospital to victim.

Summary Statement

We developed a wristband, an iOS application, and a remote server- utilizing machine learning to save the life of the user by predicting cardiac abnormalities and therefore preempting cardiac arrest.

Help Received

In addition to utilizing the MIT arrhythmia database, Dr. Nan Wang at CSU Fresno provided guidance in understanding machine learning classification functions.