

Wearable Micro-Sensors for Continuous Monitoring of the Cardiovascular System

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Abstract

Cardiovascular diseases are the leading cause of death in the world, and the prevalence is projected to increase in the next decade. The goal of this project is to develop a wearable device to continuously monitor cardiovascular activities over extended period and detect any abnormalities in early stage and act accordingly. The following device is a multi-sensor cardiovascular monitor. This device monitors the mechano-acoustic signals and detects and abnormality that leads to cardiovascular diseases (Arrhythmia, etc.). This wearable device will continuously record body motions, heart sounds and breathing patterns. These features make this device stand out among others in the market with the ability to share patient data in real time with doctors without being restricted to a single location.

In the United States, more than 27 million Americans have experienced some form of cardiovascular disease (CVD), whether that was an ischemic heart event, stroke, or hospitalization for myocardial infarction. Also, (CVDs) are the leading cause of death globally, and in 2016, there were an estimated 17.9 million deaths from CVDs globally, which is representing roughly 31% of global deaths that year. From these deaths, about 85% of them were caused by heart attacks and stroke. According to the World Health Organization, people with CVDs or with high cardiovascular risk need early detection and management to either prevent or save their lives as appropriate. This project's goal is to use a wearable detection device to scan the cardiovascular region is needed to identify potential symptoms which then helps improve treatment response and accuracy of diagnosis.

Electrical Design

The optimum design consists of an accelerometer sensor (Adxl335), an MCU (Arduino Nano), a battery pack(LP785060), and a Bluetooth module(HC-05).The MCU is programmed in the Arduino IDE using C++,which starts operating when the device is powered on by the battery. The mobile app is designed in Android Studios using Java; the GUI shows all the data that has been processed by the MCU.

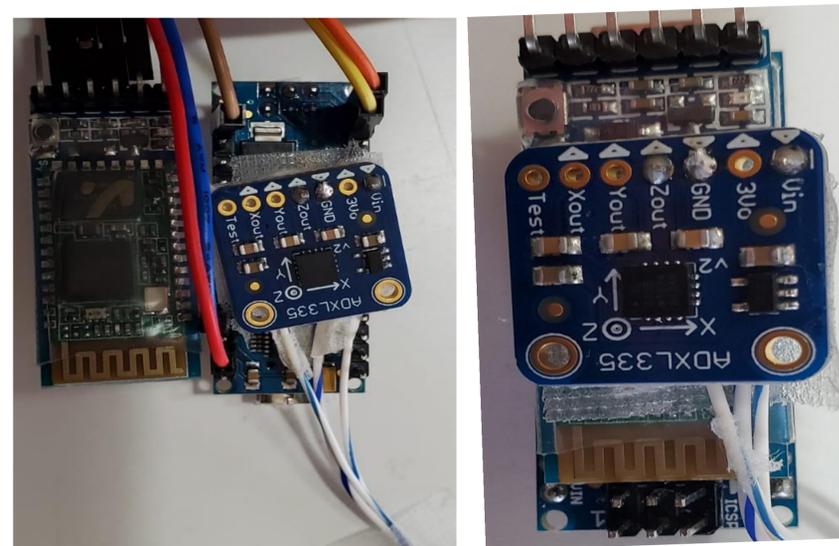


Fig1: Prototype without packaging

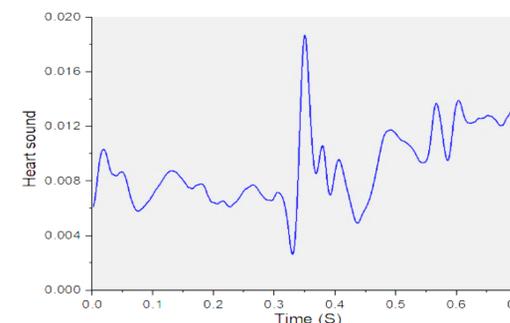


Fig2: Heart Sound

Results/Discussion

The mobile app can connect to the Arduino Nano which displace the heart sound, cough signal, shortness of breath and deep breath. The bottom figure is representing the future outcome of mobile application development.

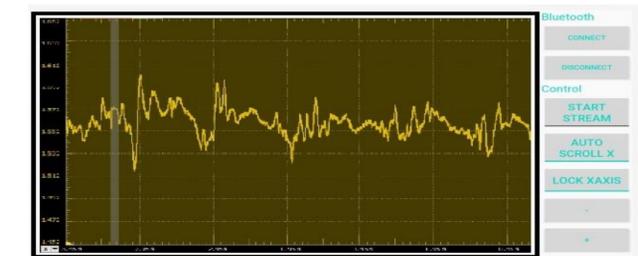


Fig3: Mobile App

Conclusions

This device continuously monitors the heart sound, cough signal, and breathing pattern, the user friendly allows the user to track and share vital health information to doctors alongside helping early CVD detection. This device can also be embedded with AI and machine learning to increase its capability.

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