FORM

Fitness Respiration Monitor

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Introduction

Improper breathing when exercising can lead to muscle and bone injuries. In extreme cases, individuals who are not obtaining enough oxygen by holding their breath for extended periods of time can faint and potentially hurt themselves and others. Injuries require lengthy rest and recovery, which slows the progression of fitness goals, and often require a visit to a doctor.

- Emergency room visits due to weight training from 1990-2007: 1,000,000[1]
- CrossFit athletes who have sustained an injury (1990-2007): 23.5%[1]
- CrossFit injuries per 1000 hours of training: 13.1[1]
- Typical Doctor's visit cost: $100-$200[2]

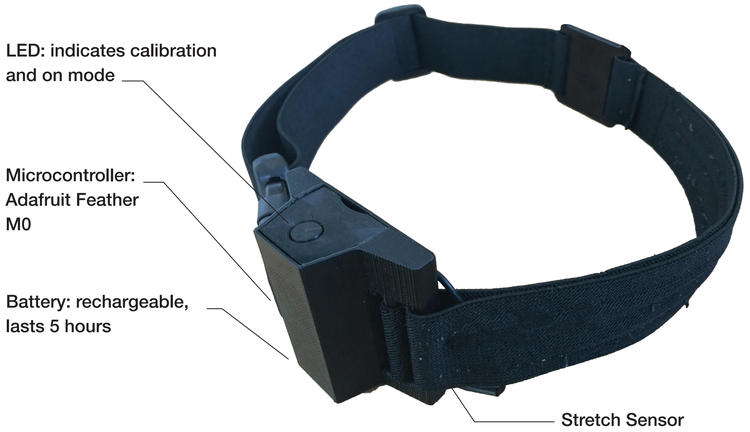
Problem

In the current market of personal fitness monitors, there is not currently an affordable and accurate device that notifies the user of dangerous breathing rates and breathing depths as they occur.

Goal

To design a comfortable and functional breathing monitor for use during exercise. Exercise enthusiasts can wear this device and be notified in real time through vibration feedback if they are not breathing deeply enough or often enough.

About The Strap



Use:

1. Adjust strap so it fits snugly around the lower chest
2. Put strap on and hold the button for 3 seconds
3. Calibrate: Three slow blinks occur, telling the user to inhale and hold their breath. Five fast blinks tell the user to exhale and hold for 5 seconds
4. LED on means product is on and functioning normally. If you feel slow vibrations, breathe deeper! If you feel fast vibrations, breathe more frequently!
5. Plug it into you computer or sync with a bluetooth device to look at your breathing habits with our handy dandy app.

Smart Watch App:

Results

With testing, we have shown that the stretch sensor is sensitive enough to track breathing and output measurements that can be used by the micro-controller to infer breathing patterns. The stretch sensor is located along the band of the device to measure chest expansion accurately. The following plots were constructed with MATLAB with data collected by the stretch sensor connected to the micro-controller. Stretch sensor values were recorded over two time periods of thirty seconds each, one where the individual was breathing normally, and another where the individual was breathing deeply.

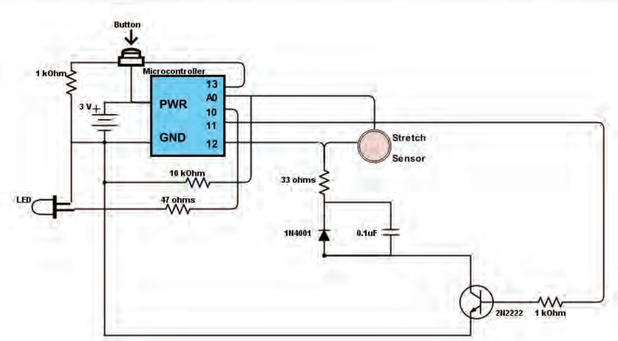


Figure 1. Diagram of electronics inside casing. All components are connected to an Adafruit Feather M0 microcontroller, and powered by a rechargeable 3.3V LiPo battery.

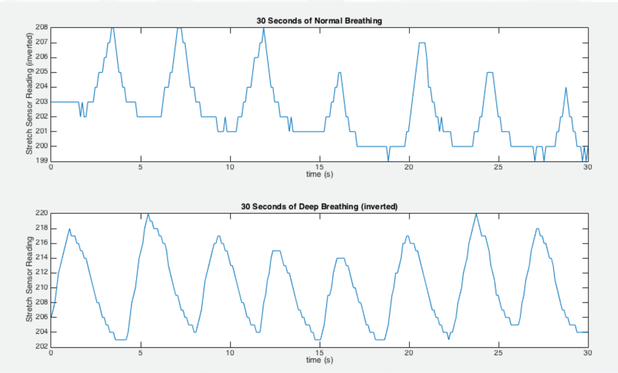


Figure 2. Stretch sensor measurements during normal and deep breathing patterns. Results show the ability of the stretch sensor to accurately track breathing.

Conclusion

- Final project uses a stretch sensor to measure expansion of chest and breathing rates
- Microprocessor processes the data and measures instantaneous breathing rates and breathing rates over time
- Vibration motor provides feedback to let the user know when he or she needs to take deeper or more frequent breaths

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References

1: http://www.legalmatch.com/law-library/article/gym-accident-statistics.html
2: http://stretchcoach.com/treat/rotator-cuff/