Compression Assistor

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Acknowledgements: Dr. Ryszerd Lec, John Alamia, Marco Janko, Dr. Alexey Aprelev

References: [1]"American Red Cross First Aid/CPR/AED Participant's Manual," American Red Cross, 2011. [2] "CPR Statistics," American Heart Association, 2011 June. [3]Physics Department, Drexel University, Philadelphia, PA. [4]http://www.arthursclipart.org/medical/respiratory/cpr%202.gif

ABSTRACT

Cardiopulmonary resuscitation (CPR) is a manual life-saving technique that, **if inaccurately performed, causes the victim's chances of survival to fall 7-10% every minute** until defibrillation[1].

The team designed a device that **measures the depth of CPR compressions given by a first responder in real time** and output that depth onto a monitor.

This allows the responder to **adjust his or her compressions accordingly during the procedure** to meet the ideal American Red Cross CPR standards.

To measure the compression depth, the *Compression Assistor* includes an accelerometer that measures the acceleration of each compression. The device uses this value to determine the displacement of the chest and output this value on a monitor.

PROJECT OBJECTIVES

The *Compression Assistor* provides **real-time feedback** to the medical responder during CPR.

The device displays the following items:

- **Depth of compressions**
- **Compression Rate**
- **Duration of procedure**

FEATURES OF FOCUS

Stable
- Fastener **covers entire surface area** of accelerometer case
  - Allows for **optimal stability** of the accelerometer
  - **Minimizes noisy signal**

Calibrated
- Includes **acceleration threshold** in code
- **Negates gravitational acceleration**

Adjustable for each responder
- Glove design is **universal**
- **One size fits all**

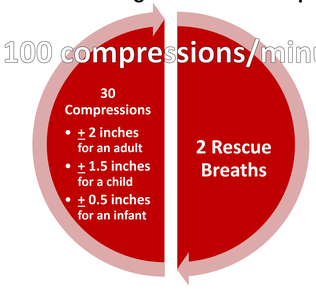
Washable
- Glove is **machine washable**

Upgradable
- Entire device can be **easily taken apart**

WHAT IS CPR?

CPR is a **combination of rescue breathing and chest compressions[2].**

American Red Cross Standard Guidelines For First Aid/CPR/AED Response



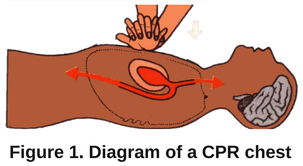


Figure 1. Diagram of a CPR chest compression[4].

- Manually **contracts ventricles** of the heart
- **Allows blood flow** throughout the body
- **Sustains oxygenation** to the brain

PROGRAMMING THE ACCELEROMETER

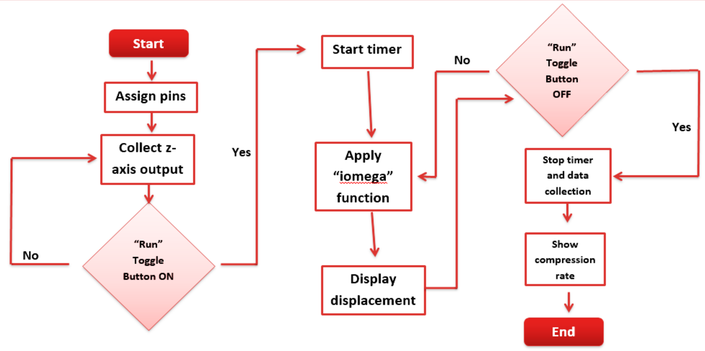


Figure 2. *Compression Assistor* Signal Flow

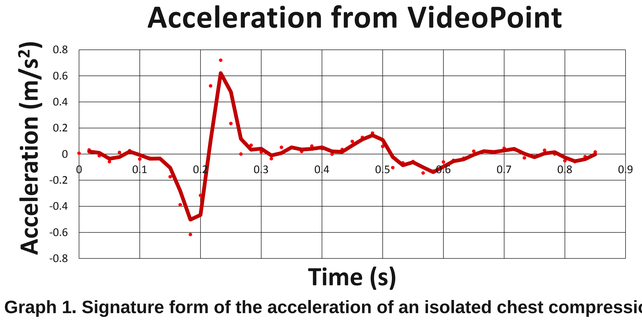
DESIGNING THE GLOVE

Universal design allows the device to be used by **both left and right-handed** users without manufacturing alternate gloves.

The fabric is stretchable and flexible to ensure that it fits **a wide range of users**.

Figure 3. Glove design of the *Compression Assistor*

EXPERIMENTAL TESTING



Graph 1. Signature form of the acceleration of an isolated chest compression.

Acceleration Comparison Table			
Trial	Acceleration (VideoPoint[3])	Acceleration (MATLAB)	Percent Error / 100 [%]
1	0.721	0.729	0.0103
2	0.632	0.653	0.0327
3	0.690	0.695	0.0062
4	0.721	0.724	0.0032
5	0.629	0.590	0.0665
6	0.554	0.587	0.0555
Average Percent Error / 100 [%]			**0.0291**

Table 1. Acceleration comparison between the acceleration data from VideoPoint Capture and the *Compression Assistor*.

It can be inferred from the data that the *Compression Assistor* can accurately detect acceleration with a **2.91% error.**

FINAL PROTOTYPE

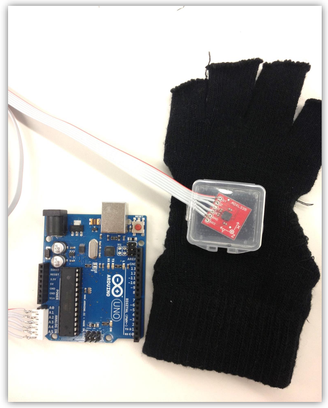


Figure 4. *Compression Assistor* Protoype

What is included:
- Glove
- ADXL335 Triple Axis Accelerometer Breakout
- MATLAB interfaced with the Arduino™ I/O Package
- Arduino™ Uno Microcontroller

As the code runs, a graphic user interface (GUI) is displayed to the responder. The GUI displays the **depth of the compressions** and the **duration of the procedure**.

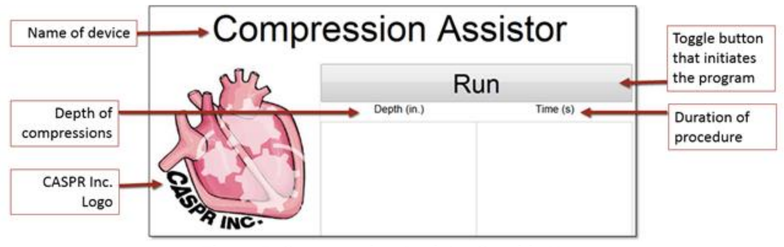


Figure 5. *Compression Assistor* Graphic User Interface (GUI)

After hitting the toggle "Run" button again to stop the program, the *Compression Assistor* displays a pop-up dialog box that informs the user how many compressions were performed per minute, namely **the rate of compressions**.

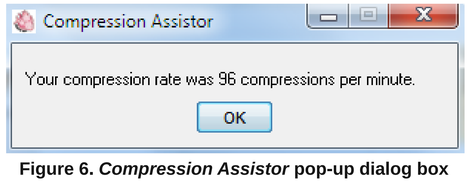


Figure 6. *Compression Assistor* pop-up dialog box

APPLICATIONS

The *Compression Assistor* will **increase the potential to preserve life** through manual CPR, **improve the accuracy** of CPR chest compressions through real-time feedback during the procedure, and **minimize injury** imposed by CPR. This device can be used by medical responders on site during the CPR procedure.

It can also be used as **a training module** during CPR training courses. The signature form of the acceleration, Graph 1, of a compression can be further analyzed to obtain **a better understanding of an accurate chest compression** and, in turn, train responders to mimic this form when performing the procedure in the future.