Background

Due to the high rate of death associated with cardiac arrest, a prototype has been developed for on the scene response. The goals were to create a citizen-friendly device that would address various lifesaving technologies associated with cardiac arrest patients such as induced mild-hypothermia, controlled oxygen deprivation, and spinal-track oscillations. The product needed to be intuitive, portable, and fast so that it could be used before trained emergency response teams arrive.

Long standing research on cardiac arrest patients shows that individuals endure the most amount of brain damage as oxygen is rushed back to the brain after the patient's heart begins beating again. Studies by the American Heart Association shows that cooling a person by 3 C decreases the amount of brain damage as long as the cooling is done within 24 hours of the original attack. Also, new research in pigs has shown that allowing a heart to not beat for 20 minutes while oscillating the subject along the spinal axis at 0.6g allows the subject to be revived without brain damage.

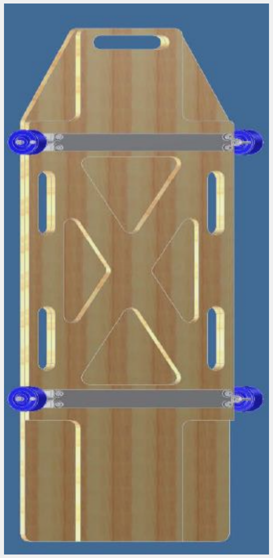
Method and Materials

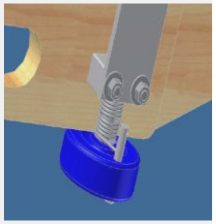
Materials necessary for the final version of the prototype include: R152a (liquid diflouroethane), a vinyl inflatable pool bed, heat plastic sealer, tubing and valves, plywood, wheels and torsion springs, supporting metal brace, and neck support brace and foam (to avoid injury to patient).

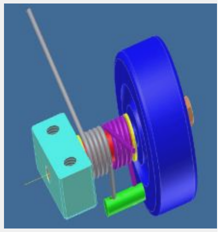
The spring system was created by attaching torsion springs to the wheels that would compress as the wheels turn. To alleviate this, steel bars were used to connect each of the two sets of wheels across the width of the bed. Spring wheels were calculated to have a rating of 34.290 lbf-in each and the wheel size was set at 3 ½ inches to accommodate for the 0.0062m amplitude.

The inflatable bed was originally to be filled with liquid diflouroethane and placed on the shaking base. Due to the channels in the inflatable bed, the gas filled at different rates and hindered efficient cooling. As a result, the bed was cut and heat-sealed again to minimize the size of each channel. Tubing and valves were used to allow each of the five channels to fill at the same time from one can of coolant. The same was done for release which allows specifically controlled release rates to maximize overall cooling.

Prototype Design

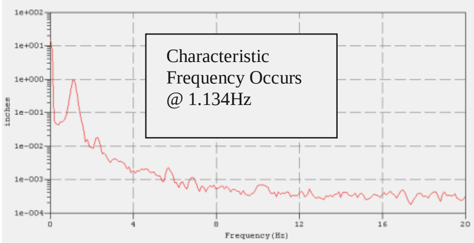






Results and Conclusions

Due to difficulty in pushing the bed by hand, half of the springs were removed before testing. As seen in the power spectrum data shown below in Figure 1, the prototype bed falls short of the required critical frequency and thus falls short of maximum acceleration. Frictional dampening also absorbs energy which slows down the oscillation.



Some modifications will need to be made to the bed in order for it to be more successful. Bigger wheels must be attached to achieve the desired acceleration and frequency. A small motor should be attached to deal with frictional dampening and drive the system to resonate at the critical frequency of 1.5Hz. The cooling system of the bed will also require modifications. The system will increase efficiency significantly once the design allows the liquid R152a to be closer to the surface of the skin instead of the gas and the heat loss from anything but the patient is minimized as to increase the amount of cooling specifically from the patient.

Applications and Future Work

Many hospitals and companies are in the process of developing more effective cooling methods to try and alleviate the long term effects of cardiac arrest. In addition, the oscillating bed is known to serve as a novel form of CPR with beneficial side effects that are currently being studied by outside companies. Though there is a similar form of cooling administered in some hospitals, this prototype is to serve as an emergency response that can be used by anybody without training. The solution is to be simple and portable so that it can be stored and if possible used in combination with AED's that are currently stored and used in public buildings.

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IPRO 319

New Technologies for Cardiac Arrest Victims

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