IPRO 319: New Technologies for Cardiac Arrest Victims

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ILLINOIS INSTITUTE OF TECHNOLOGY

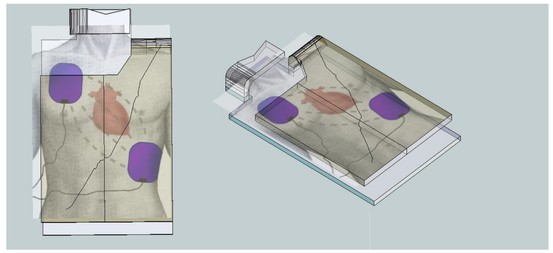
Introduction

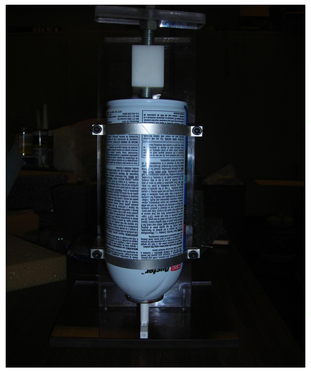
Over 250,000 people in the U.S. die annually from sudden cardiac arrest, and many that survive suffer brain damage, which can begin minutes of the heart attack. Chest compression has been the CPR method of choice for years, but a more effective method of CPR known as Whole-Body Periodic Acceleration (WBPA) has been discovered, which involves oscillating the body back and forth along the spinal axis. If WBPA were initiated shortly after cardiac arrest, lives could be saved and brain damage could be hugely reduced. In addition, cooling the body has also been investigated to reduce brain damage.

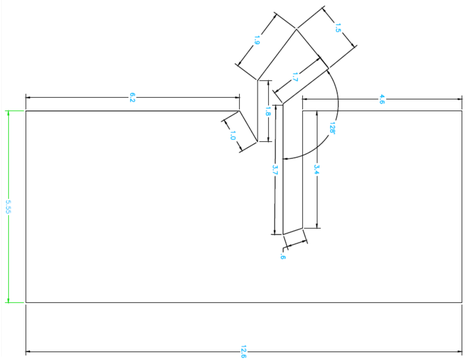
Research on cardiac arrest patients shows that individuals endure the greatest amount of brain damage as oxygen is rushed back to the brain after resuscitation.

- cooling a person within 24 hours by 3° C decreases the amount of brain damage.
- Research in pigs has indicated that 20 minutes of oscillation without heart beat and along the spinal axis at 0.6g allows the subject to not suffer any apparent brain damage after resuscitation.

Cooling Mechanisms





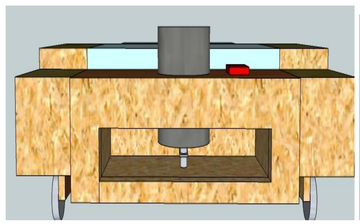


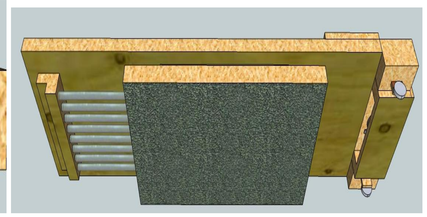
Applications and Future Work

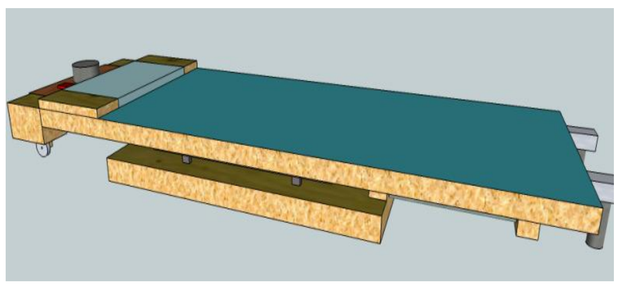
Many hospitals and companies are in the process of developing more effective cooling methods to try and alleviate the long term effects of cardiac arrest. In addition, the oscillating bed is known to serve as a novel form of CPR with beneficial side effects that are currently being studied by outside 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 used in conjunction with AED's that are already present is most public places. The use of all three technologies can help to improve survival rate and decrease brain damage amongst victims of cardiac arrest.

This past semester we have worked to develop effective prototypes. Next steps within the project should involve further perfection of the technologies so that mass production is possible. Future groups must also look into the most efficient ways to mass produce and distribute the product. Legal and ethical issues such as animal and human testing, meeting government regulations for healthcare technologies, and patent licensing must also be addressed in the future.

Shaking Mechanism

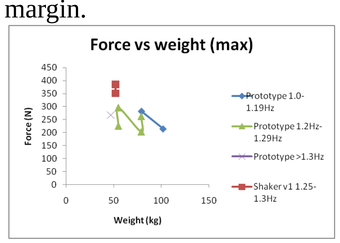






Results and Conclusions

This data is produced different people pushing the shaker with different weights. This was done so that the force required to maintain a specific weight at a specific frequency is not the same as the person pushing which also contributes into the force variable. This experiment is intended to give an approximation the motor size to power the shaker. From the data, we can see that as the weight increases, the frequency decreases. As different people push with same weight and same frequency the force varies by quite a margin.



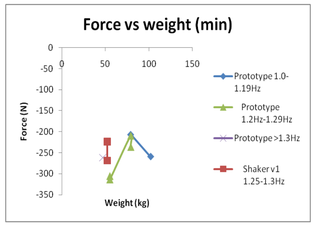


Figure 1: The graph on the left illustrates the maximum force that is created for varying body weights and frequencies. The graph of the right illustrates the minimal force that is created when weight and frequency is varied.

Some modifications will need to be made to the bed in order for it to be more successful.

- They prototype should be designed such that the weight is minimal allowing for easy portability and storage.
- Different power sources need to be investigated to further modify the current motor used.

The cooling system will increase efficiency significantly once the design allows the liquid R152a to be closer to the surface of the skin.

Calculations

•Engineering Equation Solver (EES) software calculates the heat capacity of R152a at -238.5 kJ/kg.

- Ammonium Nitrate and water reaction has a heat capacity of -197.4 kJ/kg.
- Phase-change cooling technique using R152a is more efficient.

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