Utilizing Cardiac and Pulmonary Function with Piezoelectricity to Power a Cardiac Pacemaker, Year II

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The purpose of this experiment was to find a way to provide a constant supply of electrical power to a cardiac pacemaker utilizing cardiac and pulmonary motions in conjunction with piezoelectric generators. Cardiac pacemakers are powered by a lithium battery with a finite lifetime. More than 60% of the batteries implanted run out of charge within 1 to 5 years (according to Frederick Seitz Materials Research Laboratory). The only way to replenish the battery is to surgically remove it and put in place a fresh battery. These surgical procedures to replace the depleted batteries of implantable devices are thus essential, even though it exposes patients to additional health risks, heightened morbidity, and even potential mortality. A model (unsuccessful) and simulation (successful) of both lungs and heart were created. Five trials were conducted for both cardiac and pulmonary simulations, and the average and standard deviation were calculated. An oscilloscope was used to record voltage, which was then compared to requirements of a pacemaker. According to the average data, the simulated motions of the heart and lungs produced 141.63 mW of power every second, which is sufficient to power a cardiac pacemaker, which requires only 1mW-10μW. Using online data gathered of height, heart rate, and breath rate of children aged 0-18 (from the Online Cleveland Clinic), the power generation of cardiac and pulmonary motions of subsequent ages was also estimated. In conclusion, the natural contractile motions of the heart and lungs are more than enough to power any standard cardiac pacemaker.

Awards Won: