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

Somawardana, Isuru

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 a piezofilm (converts kinetic energy to electrical energy). 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. The only way to replenish the battery is to surgically remove it and put in place a fresh battery. These surgical procedures are thus rendered necessary even though they expose patients with preexisting health conditions to additional health risks. In previous experiments conducted by the researcher, a model (unsuccessful) and simulation (successful) of the contractions of the lungs and heart were designed and constructed. An oscilloscope was used to record voltage at 50 millisecond intervals. The simulated motions of the heart and lungs produced sufficient electricity to power a cardiac pacemaker. Fatigue testing of the piezofilm over 10 weeks concluded that the material is resistant to structural damage and loss of electrical output. In this year's experiment, various silicone elastomers with 1%, 2.5%, and 5% multi-walled carbon nanotube (MWCNT) reinforcement were created and tested to create stress-strain curves. The 2.5% MWCNT elastomer had a very similar stress-strain curve and Young's Modulus to that of left ventricle tissue. The potential to revolutionize biomedical devices by finding a sustainable and reliable power supply is a significant motivation for continued research in this field.

**Awards Won:**