



**CALIFORNIA STATE SCIENCE FAIR  
2013 PROJECT SUMMARY**

<b>Name(s)</b> Noah R. Crousore	<b>Project Number</b> <b>J0906</b>
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**Project Title**  
**Arduino-based P.E.A.K Pad for Carpal Tunnel Syndrome**

**Abstract**

**Objectives/Goals**  
Carpal tunnel syndrome (CTS) is a clinical syndrome manifested by characteristics, signs and symptoms resulting from an entrapment neuropathy of the median nerve at the wrist. I wondered if it were possible to design a computer keyboard device that provides both active noninvasive therapeutic and prophylactic benefits for carpal tunnel syndrome. I believed this could be accomplished through Pulsed Electromagnetic Field Therapy (PEMFT), in which noninvasive electromagnetic impulses are applied to the target area, accelerating the natural anti-inflammatory cascade via the binding of calcium and calmodulin, releasing anti-inflammatory nitric oxide. The goal of my project is to see if it is possible to integrate the benefits of PEMFT into a keyboard accessory for carpal tunnel syndrome.

**Methods/Materials**  
I used two 60 cm long wire coils (PEMF applicator), a PEMF portable emitter, an Arduino UNO# Open-source electronics prototyping platform, TRIFIELD Meter Model 100-XE Magnetometer, Tektronix TDS-210 Two-Channel Digital Real-Time Oscilloscope, ADESSO Ergonomic Keyboard Model PCK-208B, SONY KFRP Series Model PCVA-KBP1/UB Standard Keyboard, and a Demarle F11 Silicon Cooking Pad. I measured the vertical and horizontal strength of the electro-magnetic field generated through varying levels of impedance (Z) to ensure that the signal would transmit through the keyboard and pad.

**Results**  
After validating the fundamental carrier frequency of the electromagnetic coils (27.12 MHz), I attempted to find a way to incorporate it into a computer accessory. After many preliminary design schematics, I was able to construct a device such that there was as minimal field mitigation as possible, which emitted a readable electromagnetic field. I then spent hours trying to figure out a powering method. I programmed an Arduino as a power unit that can be plugged into a computer directly, or a wall-mounted power outlet. Also, by using the Arduino unit for power, I was able to modulate therapeutic time intervals easily, making the device customizable for each individual's therapeutic regimen.

**Conclusions/Discussion**  
I believe I have built an effective PEMF generator and designed it in a way to power it with the computer or with a traditional power outlet. I have tested the EM field that my device is generating at the target anatomy in my wrist, and surrounding my device is a distinct, readable electromagnetic field.

**Summary Statement**  
I designed and built a therapeutic intervention, powered by an Arduino microcontroller that integrates the benefits of Pulsed Electromagnetic Field Therapy for carpal tunnel syndrome.

**Help Received**  
Parents helped collect data; Science teacher lent materials and her guidance; Used lab equipment at Adori Labs under supervision of Mr. Nathan Iyer; Nathan Iyer also gave advice and guidance during the project.