# CALIFORNIA STATE SCIENCE FAIR
## 2014 PROJECT SUMMARY

**Name(s)**
Tarun S. Chiruvolu

**Project Number**
**J1205**

**Project Title**
# Healing Bruises with Wearable Devices: The Effect of Ultrasound Treatment on Various Bruises, Aches, and Pains

**Abstract**

**Objectives/Goals**
I play soccer, so sometimes I get hurt and get a bruise. Bruises and other aches take quite a while to heal, so I researched on how to speed up this process while still making it easy and comfortable without a hospital visit. I hypothesized that using a wearable device that administered ultrasound would help cell growth and have positive thermal effects, therefore healing the injury more efficiently.

**Methods/Materials**
I used an Arduino microcontroller board to generate a pulsed oscillating voltage to drive a 25mm 1 MHz ultrasonic disc. All electronic components were assembled into a compact wearable pouch. I modified an Arduino program available online and added buttons to it to select treatment frequency (20kHz, 40kHz and 1MHz). Another button would start treatment to run 3 times: 2 minutes on/15 seconds off (to prevent overheating of treatment area) to a 6 minutes total. With a multimeter, I verified frequency, and measured current, voltage to ensure output power was much less than 180mW/cm2, a recommended safe limit. 5 different wounds were tested: 2 bruises, 1 pulled leg muscle, 1 cut and 1 cold sore. Before and after each treatment, I recorded pain levels using a 0-10 scale (0- no/low pain, 10- most pain). I took photographs to record visual changes after each treatment. For controls (projected time), I used ranges of healing times found in published data for similar wounds.

**Results**
In all of the 5 wounds tested, the wounds treated with ultrasound showed that they healed faster (by about 25% to about 50%) compared to the controls. Results also showed that the most severe of the injuries healed the fastest compared to projected time.

**Conclusions/Discussion**
My hypothesis was supported because the injuries healed faster than reported projected times without ultrasound. A reliability issue is 1) the wounds tested are assumed to be similar to cases described in published data for projected healing time 2) not enough test subjects due to short time window and difficulty in obtaining support from research physicians/institutions. Therefore, to draw clear conclusions additional work is needed. The independent variables (duty cycle, frequency, treatment time, intensity) and impact on dependent variables (pain scale, visual appearance, and healing times) can be studied more thoroughly with support from a medical device company as future study.

**Summary Statement**
My project explores the possibility of using a wearable ultrasound device to heal bruises and aches efficiently.

**Help Received**
I received help from my parents in coding and building the device.