



**CALIFORNIA STATE SCIENCE FAIR
2015 PROJECT SUMMARY**

Name(s) Srinath Somasundaram	Project Number J0328
Project Title A Novel Design and Evaluation of an Air Cushioning Mechanism for Helmets to Reduce Impact Acceleration on the Head	
<p style="text-align: center;">Abstract</p> <p>Objectives/Goals The purpose of this engineering project is to reduce impact acceleration felt on the head. I added an air bladder similar to an airbag in a car in between the padding and shell of a model helmet to lengthen the time of impact and reduce force. The air bladder would be deemed successful if it reduced accelerations at the head by 50 g#s or more.</p> <p>Methods/Materials I had to build a helmet setup with accelerometers representing the head and the helmet accelerations to be able to trigger the air bladder when a 1kg weight from a tower hits. First, I built a 20-foot tower using pipes to create the equivalent accelerations of a football hit (100-150 g#s). Next, I made a model football helmet using Polycarbonate and Polyurethane. The final step was the air cushioning mechanism. For this, I used a balloon, an air compressor, tubing, a solenoid valve, wires, two accelerometers (one attached to the shell and the other attached to the padding, corresponding to helmet and head accelerations), and an Arduino microcontroller. I coded the microcontroller to read and print the accelerations and trigger the valve to release air from the compressor to the balloon when it sensed an acceleration above 50 g#s. I dropped a 1kg weight from the top of the tower, and when the threshold was reached, the mechanism was triggered. I repeated this four times with and without the mechanism.</p> <p>Results The data of repeated tests showed that the air cushioning mechanism does significantly reduce acceleration on the head throughout the impact. Three tests with the bladder show that while the helmet accelerometer#s readings were high, the head accelerometer#s readings were low. On the other hand, only one test without the air bladder showed a similar 100 g reduction between the helmet and the head accelerometer readings. The high-speed camera footage revealed that the balloon almost reflected the hit, while the helmet without the balloon didn#t give much resistance and was easily compressed.</p> <p>Conclusions/Discussion All data that was gathered showed significant reduction in acceleration with the air bladder. Also, the air bladder mechanism appeared to dampen out any oscillation in accelerations on the head. This would lead to smaller forces on the head and prevent the brain from bumping into the head from residual force, decreasing the likelihood of a concussion and other brain damage.</p>	
Summary Statement This project determines if putting an air cushioning mechanism triggered by a microcontroller in a helmet would reduce impact accelerations on the head.	
Help Received Mentor Dr. Ismail supervised and advised me.	