CALIFORNIA SCIENCE & ENGINEERING FAIR
2019 PROJECT SUMMARY

Name(s)

Ashutosh Kandala

Project Number

S0312

Project Title

A Novel Approach to Reducing the Amount of Headfirst Injuries on a Bicycle

Abstract

Objectives

The objective of this study was to design a self-contained airbag that reduces the impact of over-the-bars crashes. The airbag was intended to be embedded in the stem of a bike so it would be easily interchangeable.

Methods

A spring-loaded nail, activated by nichrome wire, was used to puncture the CO2 canister required to inflate the airbag. A gyroscope sensor along with an ATMega 328 micro-controller was used to automatically inflate the airbag when the bike reached an angle between 20 and 30 degrees relative to the ground (simulating a fall). The code run on the microcontroller was entirely self-developed. Different sizes of airbags(40cm X 60cm & 60cm X 82 cm) made of ripstop nylon, were used for testing. A pressure sensor was placed within the airbag to note the rate at which air escaped. The GL248 code for the pressure sensor was used from http://science.cleapss.org.uk. The impact of the rider on the airbag was tested by replacing the seat post of the bike with a wooden dowel attached to a soccer ball with a helmet on it. An FSR sensor was placed between the soccer ball and the helmet to measure the impact pressure. The code for the FSR sensor was used from https://learn.adafruit.com/force-sensitive-resistor-fsr/using-an-fsr

Results

The results showed that the effectiveness of the airbag was extensive. When the impact on the airbag was tested, compared to the impact on the bare ground, the force (in newtons) on the head was minimized by over 50%. Between the different sizes of airbags tested, the airbag that consistently showed a better impact reduction rate was 40cm X 60cm. This airbag also repeatedly inflated between 0.3 and 0.4 seconds when activated. The inflation mechanism was successfully activated 95% of the time. Furthermore, the airbag successfully inflated when the bike reached an angle of 20 to 30 degrees relative to the ground.

Conclusions

This study allowed for the creation of a fully functional prototype of an airbag that could be embedded in a bicycle stem. The inflation mechanism designed in this experiment introduced the airbag-level inflation mechanism that can prevent injuries. The results of this experiment can be used to further research as to how over-the-bars injuries can be prevented using airbags embedded in bikes

Summary Statement

I created a self-contained airbag embedded in the stem of a bike that reduces the impact of over-the-bars crashes by over 50 %.

Help Received

I designed, and preformed prototyping by myself. My parents helped to supervise me when dealing with dangerous materials. My science teacher reviewed my final abstract and results.