# CALIFORNIA STATE SCIENCE FAIR
## 2009 PROJECT SUMMARY

**Name(s)**
Caroline M. White

**Project Number**
**S1623**

**Project Title**
## Automatic Die-rolling Machine for Defect Determination

**Abstract**

**Objectives/Goals**
The goal of this project was to design and construct a die-rolling machine used to determine if a die is defective or not by compiling the statistics of the numbers rolled by the dice.

**Methods/Materials**
I first built the dice tumbler, and then attached the dice tumbler to a stepper motor. I also mounted a light source (LED board) and a web cam above the dice tumbler to allow the machine to take pictures of the die being testd. After I built the machine, I programmed an application that basically spins the dice tumbler, takes an image of the die, and then processes the image. The image is processed by converting the image to black and white, negating the image, and then using connectivity analysis to determine the number of "blobs", or dark spots, on the die. These blobs are filtered out based on their areas and how circular they are, and the blobs that aren't filtered out are considered indents, are counted, and the number of indents is displayed on the user interface.

**Results**
I tested 21 dice of varying colors. Of the 21 dice, 16 were tested without error on the machine's part. Of those 16 dice, I deemed four of them, or 25% of them, defective based on a +/-10% defective threshold that I set. This means that if a die rolls a number with a probability 10% above or below the ideal probability (1/6), I considered it defective.

**Conclusions/Discussion**
Overall, the machine was a success. The only dice the machine had trouble reading were some of the colored ones, due to the glare from the lighting blending in with the indents on the dice while the image was being processed. However, the tumbler ended up being extremely efficient and precise, and the image quality from the web cam was satisfactory. The lighting, while not perfectly uniform works, well enough for my algorithm to work, and the algorithm itself works quite well. With a few minor adjustments, this machine could be put out for commercial use.

**Summary Statement**
My project is a system capable of gathering and displaying the statistics of a dice.

**Help Received**
Advisor helped supply equipment and material, and helped with program