



CALIFORNIA STATE SCIENCE FAIR 2013 PROJECT SUMMARY

Name(s) Cameron C. Jones	Project Number 33019
Project Title We're Jammin': Using the Jamming Principle to Construct a Universal Gripper	
Objectives/Goals My goal is to construct a universal gripper based on a flexible membrane (balloon) filled with a granular substance (e.g. coffee grounds) that is capable of picking up and holding a wide variety of objects. When connected to a vacuum, the granular material becomes rigid and the membrane can grasp objects without having any prior knowledge about the shape, size, or configuration of the object. This design can be used for many robotic applications in factories or other environments. Abstract Methods/Materials To test the capability and design of my gripper, I performed a series of tests to determine its limits. I tested the ability of the gripper to grip and hold three different shapes with increasing weights. The first shape I tested was a 40mm Ping-Pong ball. The second was a 16mm diameter hollow brass rod, and the third was a 48mm square block. For each shape I held the item for 5 seconds to see if it could hold the weight. The test was repeated 10 times for each weight to estimate the reliability of the gripper. I then increased the weight and repeated the test until high failure rates were observed. Results The universal gripper lifted a 40mm Ping-Pong ball reliably up to 250g in weight. It lifted a 16mm x 305mm cylindrical rod reliably up to 275g, and was able to lift a 48mm x 48mm x 16mm block up to 178g in weight. The performance of the gripper was more variable when I used the smaller diameter cylindrical rod than the Ping-Pong ball. I believe this is due to the positioning of the rod on the balloon being more varied than a larger sphere, which normally was closer to the center of the balloon. The block was the most challenging object to lift given its size relative to the diameter of the balloon. The gripper is capable of picking up a variety of different sizes, weights, and shapes without knowing any further information. Conclusions/Discussion I demonstrated that building a universal gripper using the jamming technique was possible. I successfully built a gripper that lifted different objects with significant amounts of weight. The gripper is capable of picking up a variety of different sizes, weights, and shapes without knowing any further information.	
Summary Statement My project demonstrates a robotic gripping device capable of picking up objects with different sizes and weights without complex control software.	
Help Received My dad helped me with the purchase of the parts, the attachment of the vacuum lines, and with debugging my control program.	