Claw mechanism

Goals

- Be able to grasp plastic bottles (20 oz), aluminum cans (in both upright and laying down positions)
- Minimize torque required to open claw to maximum position
- Make all components of the claw small enough to print on a 3D printer

Prototype 1

We decided to use a four bar mechanism to open the claw because it can easily be actuated by a motor and can be easily optimized. We decided to use surgical tubing to keep the claw closed on what we are recycling and use the motor to open the claw. This would reduce the amount of time that the motor needs to run, thus saving energy. We decided to use wood links and colored pencil pin joints in order to finalize the dimensions and functionality of the four bar. Using excel and SolidWorks we maximized the transmission angle and mechanical advantage of the four bar at the most open position of the claw.

Prototype 2

For the second prototype we wanted to completely 3D print the claw. To do this we decreased the lengths of all the links to less than 11 inches so that they could be printed on a 3D printer. We did some printing tests to determine that 0.016" is the best pin joint clearance for joints made on a 3D printer.
From the second prototype we learned that the 3D printed pin joints quickly wear down and become too loose to be functional so we decided to design snapping joints. The snapping joints are compliant enough to deflect to enter the pin joint hole and the tabs on the end keep the links from coming off the joints even when loosened over time. These worked much better than the original pin joints. The other main design change was to move the location of the elastic that helped to keep the claw closed. Initially it was thought that the bottle could move aside the elastic, but the surgical tubing was too strong. Because of this we moved the elastic out of the claw entirely for the final design. The surgical tubing was replaced with a rubber band to reduce the force required to actuate the claw so that a servo could open it. This was needed because the motor
driving the arm was not powerful enough to drive the arm with the mass of a motor at its end. Teeth were added to the claw for aesthetics. The final design is capable of grabbing a plastic bottle and can in an upright position and a can laying down.

3D printed snapping joints

Prototype 3 holding a bottle
Claw grasping a laying down can