b. Prototype Testing Protocol

Cost analysis

For all three prototypes the equipment and materials required to create each device will be calculated. All of our design can fit inside a standard trash can. The success of each prototype will be based on the expenses of the materials needed to customize each standard trash can excluding the trash can itself. The cheaper the solution is, the more successful it will be considered in this specific category.

Recovery rate (Physical Test 1)

For all three prototypes, eighteen scaled paper towels will be dropped into the mechanism. For prototypes 1, 2, and 3 paper towels will be cut into fourths, sixths, and halves, respectively, to account for the smaller scales of the models. The number of paper towels that are successfully sorted will be recorded. For prototype 1, these will be paper towels that landed on top of the middle shelf. For prototype 2, these will be paper towels that made it into the cup. For prototype 3, these will be paper towels that were sorted to the correct side of the bin. This process will be conducted for three trials and the average between all tests will be used to determine the average recovery rate for each prototype. The higher the recovery rate, the greater the success.

Contamination rate (Physical Test 2 and Thought Experiment 1)

Prototypes 1 and 2 will be tested by alternating dropping in scaled contaminates and paper towels one at a time. From the data provided by the client, each game had about a 20% contamination rate. Based off this, one contaminate will be dropped in for every four paper towels. For each trial, a total of 16 paper towels and four contaminates will be "thrown away". After each trial, the number of contaminates and paper towels in the paper towel collection area (as specified in the previous test) will be counted and recorded. This process will be completed three times for each prototype. To calculate the contamination rate, in each individual trial, the number of contaminates will be divided by the number of paper towels. The three values from each trial will be averaged to calculate the average contamination rate for each prototype. If the contamination rate is 20% or higher, then the prototype would have failed to improve on the original design implemented by the client. If the rate is less than 20%, this would indicate an improvement in design.

The third prototype will be tested by using a thought experiment because the mechanism functions based off the weight of the object rather than the size. We will use the lists of contaminates provided by the client and generated by the class as our sources. The average weight of each object will be compared to the weight of a used paper towel. This will be used to predict if the item would tip the balance or if it would fall into the paper towel bin. To calculate the contamination rate, we will divide the number of contaminates that fall into the paper towel bin by the total number of contaminates examined. The large sample size of potential contaminates will make sure that our results will be realistic.

Mechanical reliability (Physical Test 3)

For all the prototypes, scaled paper towels will be "thrown away" into the mechanism. When the mechanism becomes clogged to the point where no more paper towels can be thrown into the bin without human intervention, the number of paper towels in the bin will be recorded. For all prototypes, this process will be repeated five times. The number of paper towels from all five trials will be averaged to get the average number of paper towels that each prototype can handle. The larger the number, the better the mechanical reliability.

c. Test Results for Top 3 Alternatives

Based upon the recovery rate test results it can be determined that Prototype 3 has the highest recovery rate at 100%. The paper towels never tipped the scale and ended up on the wrong side.