Solar Recycl-o-Sort

BLUE A INC

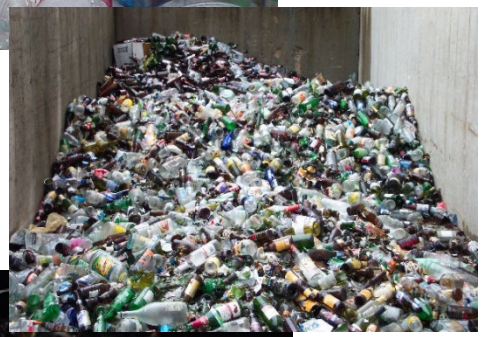
"Working for a Bluer World"

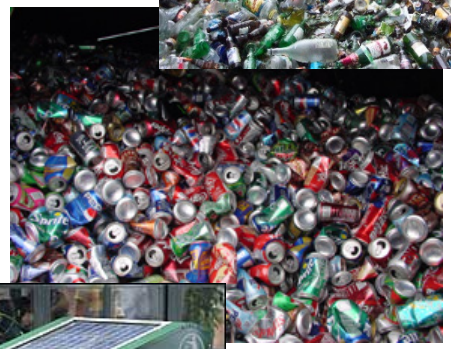
2.009 Sketch Model
October 4th 2007

BLUE A INC

Problem

- Solar Powered *Compactor and Sorter* for Recyclables
- Problems with Current Products: After compacting, cannot separate recyclables from trash

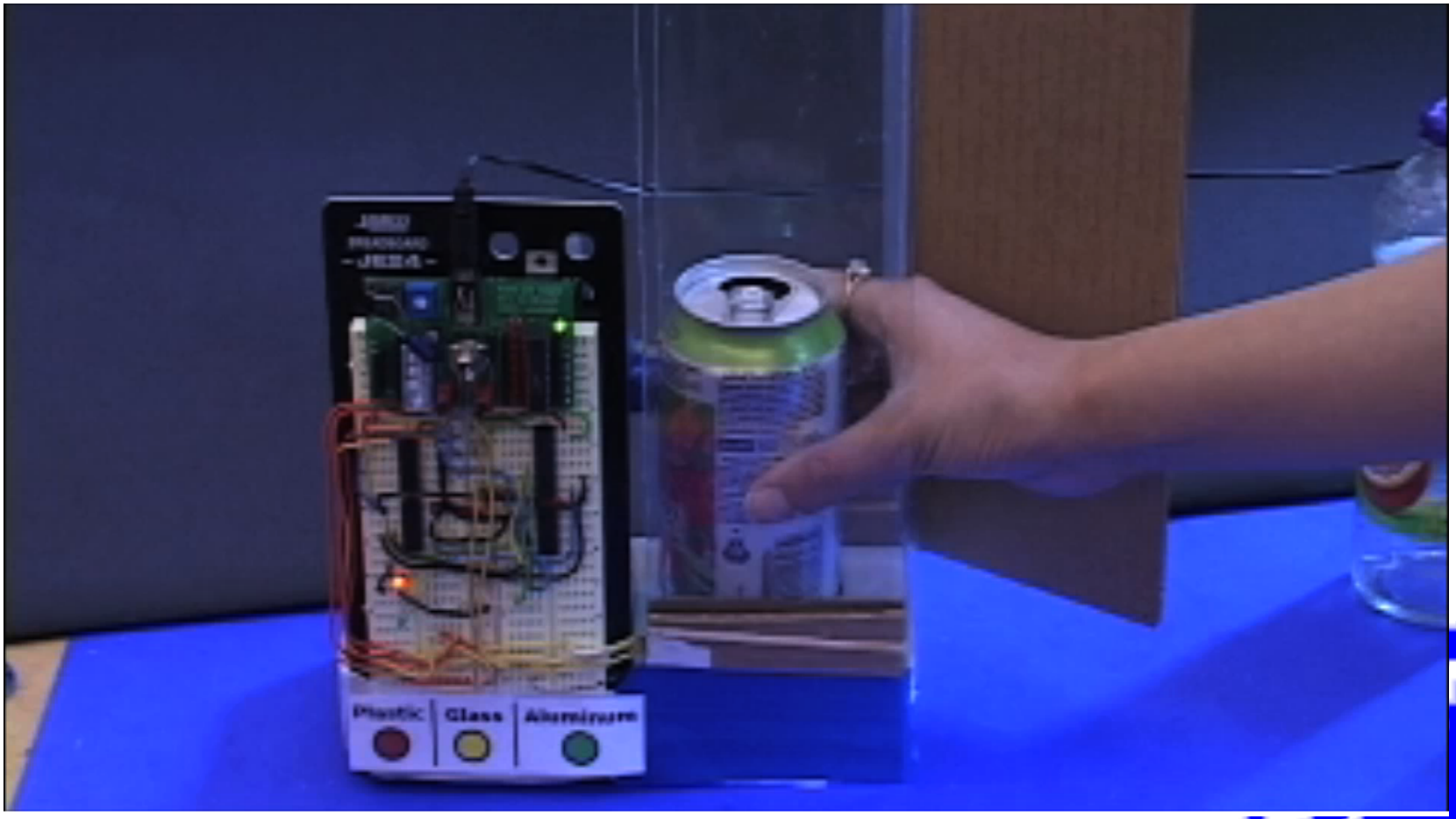




Market

- 9000+ Curbside Recycling Programs in U.S.
- Market $4.5 million dollars per year
    - For 10 years
    - 10% penetration
- Benchmarking: Most similar product price = $4300.

Demonstration



Design Requirements

Initial Customers

Codman Square: Cynthia Loesch

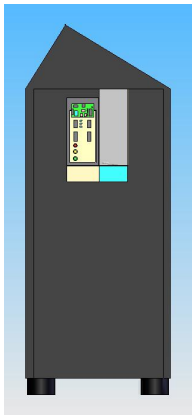
Boston Harbor Association: Vivien Li

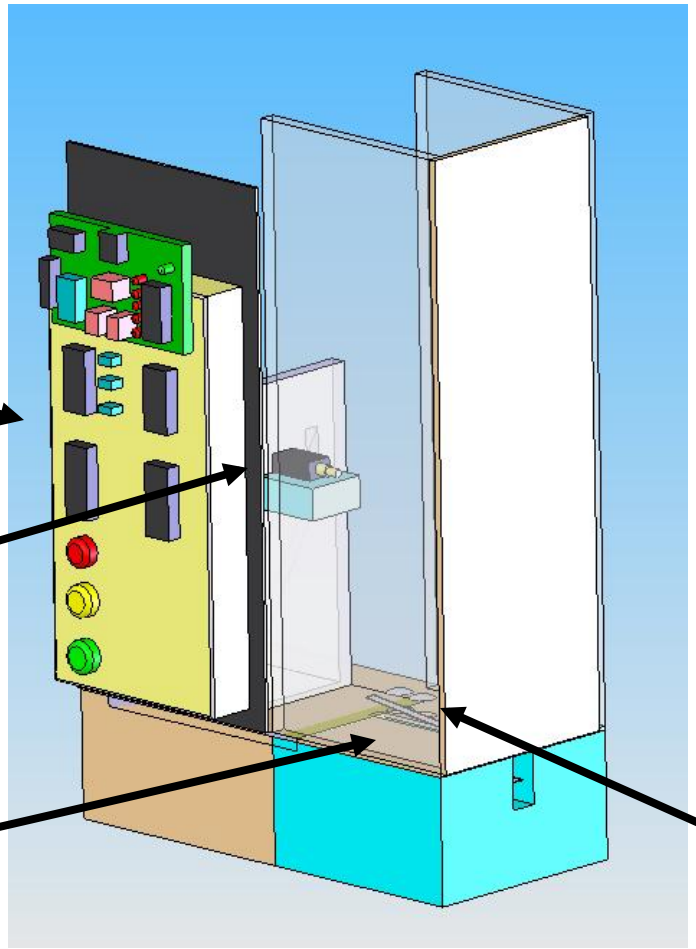
Customer Needs

- Sort aluminum cans, plastic and glass
- Compacts recyclables to reduce pickups
- Low Cost
- Low Power, portable
- No Maintenance
- Operates under wet and sticky conditions
- Aesthetically pleasing and intuitive

Vivien Li

Design Concept: Sorting





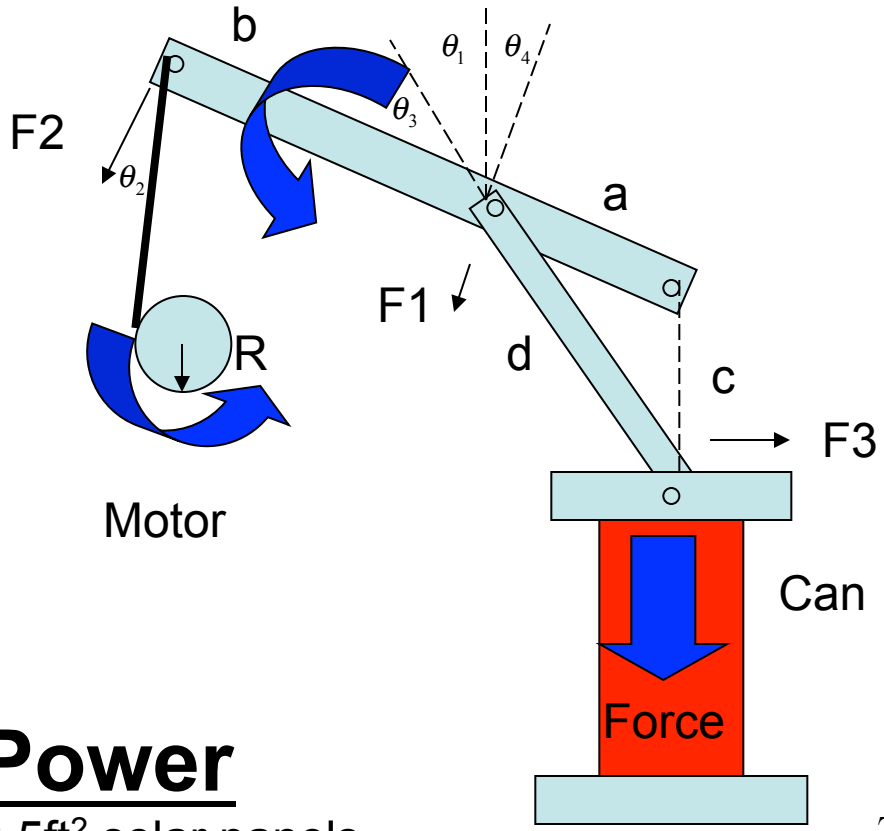
Learned from Model

- Low cost parts work
- Simple digital logic works
- Can sort between aluminum, glass, plastic

Future Work

- Redundancy
- Automation with servos
- Component Robustness

Design Concept: Compacting



Experimental Results

Container	Force	Energy
Aluminum Can	362N	43.4J
Plastic Bottle (no top)	453N	90.6J
Plastic Bottle with top (estimate)	1200N	240J
Gatorade/ Vitamin Water (no top)	544N	92.5J
Poland Spring (no top)	249N	49.8J

Power

3.5ft^2 solar panels

Generate 38 W-hrs (137kJ)*

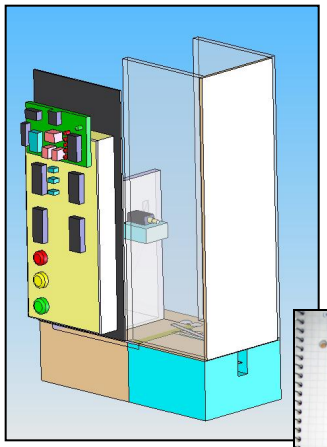
Crushing ~570 bottles/day

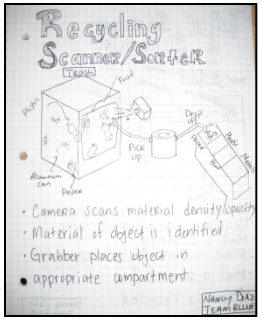
*Boston in the Winter

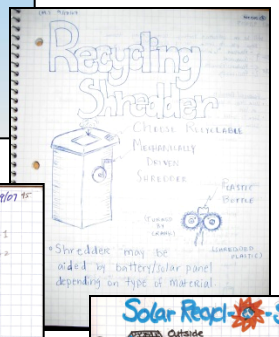
$$T_{Motor} = \frac{a}{a+b} R \frac{Force}{\cos(\theta_4)\cos(\theta_2)}$$

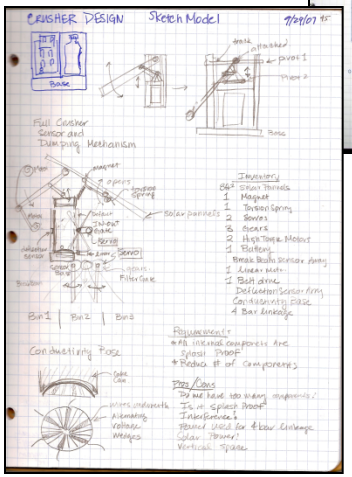
Torque from Motor ~ 2.17N*m

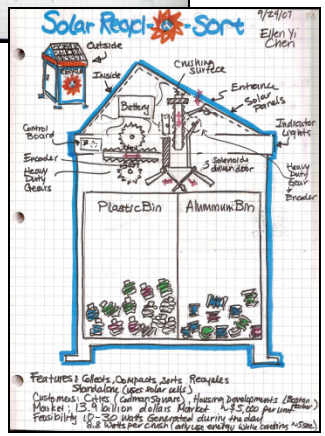
Design Alternatives











Sorting

- Optical Sorting (camera)
- Break Beam Sensors
- Thermal Conductivity Material Sensing
- Melting
- Crushing Force Sensing
- Eddy Current Sensing
- Etc…

Crushing

- Two-sided crusher (up/down and left/right)
- Linear motor crusher
- Shredding/Breaking
- Crushing while in the bin
- Crushing before sorting
- Etc…

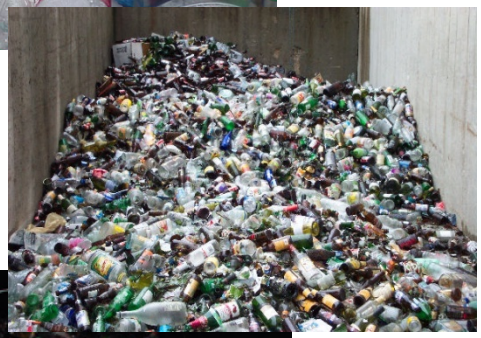
Questions ?

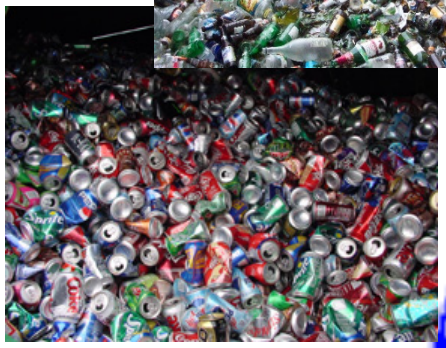
Backup Slides

Additional information is in the following slides covering benchmarking, market, customer needs, concept, design alternatives, and experimental data.

Problem

- Produce >245 million tons of waste (2005)
- Currently recycling:
  - 44.8% of Aluminum cans
  - 34.1% of Plastic bottles
  - 25.3% of Glass containers
- Current Products:
  - After compacting, cannot separate recyclables from trash





Market

- Codman Square
  - Contact: Cynthia Loesch
- Boston Harbor Association
  - Contact: Vivien Li
- Curbside Recycling Programs
  - 9,000+ U.S. programs (2005)
- Municipalities
  - Cities, Parks, Suburbs
- Virtually untapped $45+ million market

Benchmarking

- Industrial Compactors (balers)
  - $5,000
- Industrial Sorter
  - Worker paid $9/hr
  - Optical Sorter ~$100-200K
- Home Compactors
  - $400
  - 1/3 hp, F = 9000N
- **Curbside Compacting**
  - Solar Compactor on Newbury ($4,300)
  - $860,000 in competitor products

Design Requirements:

Customer Needs

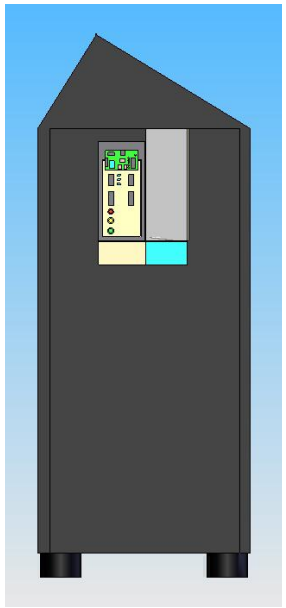
- Sort aluminum cans, plastic and glass
- Compacts recyclables
- Low Cost
- Low Power, portable
  - Operates on solar panels
- No Maintenance
  - Operates under wet and sticky conditions
  - Compacts to reduce pickups
- Aesthetically pleasing and intuitive
- Reduce environmental footprint

Vivien Li

Risks and Feasibility

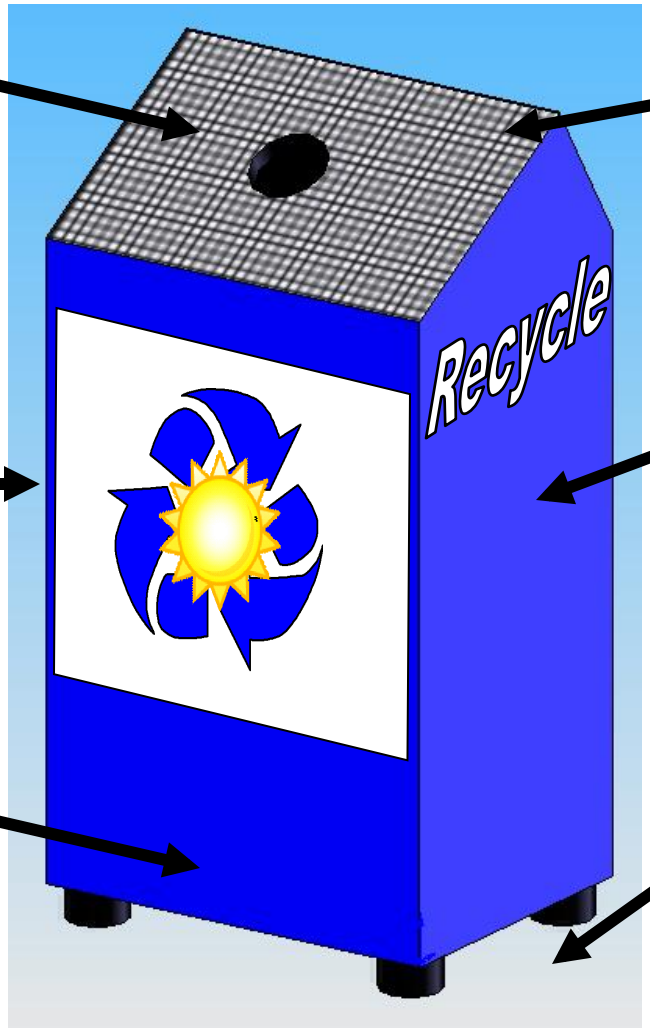
- 3 tier sorting system
  - Object entry
  - Metal differentiation sensor
  - Deformation sensor
- Compacting mechanism
  - F_{max} = 1,200 N
- Power (3.5ft^2 surface)
  - Generate 38 W-hrs (137kJ)
  - Boston Winter
  - Crushing ~570 bottles/day

Design Concept



Round hole to encourage bottles and cans

Solar Panels



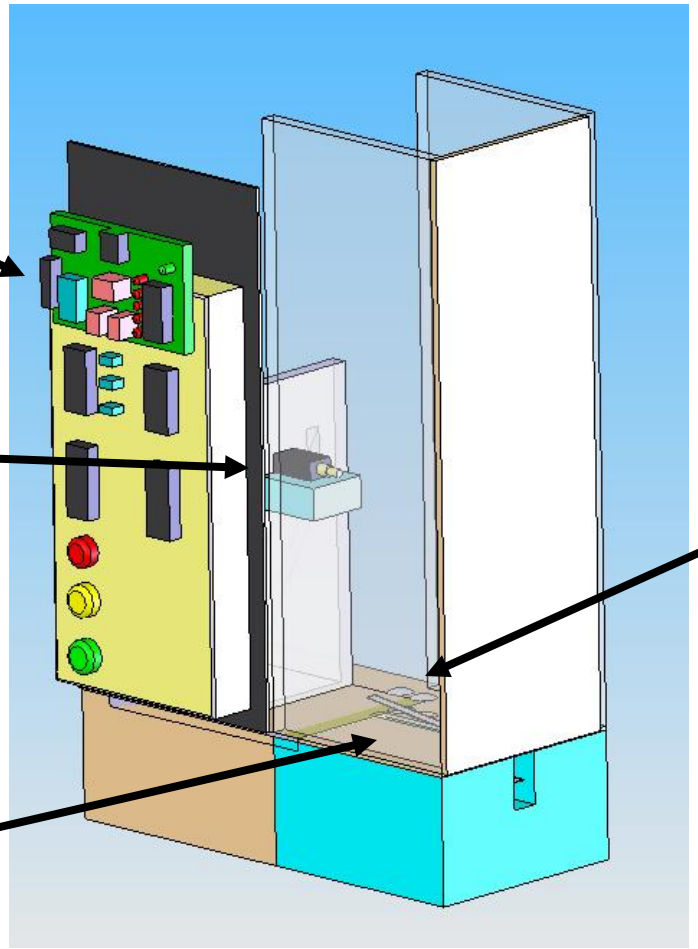
Access panel for removal of recyclables

Intuitive color and entry for recyclables, easy product to use

Blue color to encourage recycling

Off the ground to prevent water collection

Design Concept: Sorting



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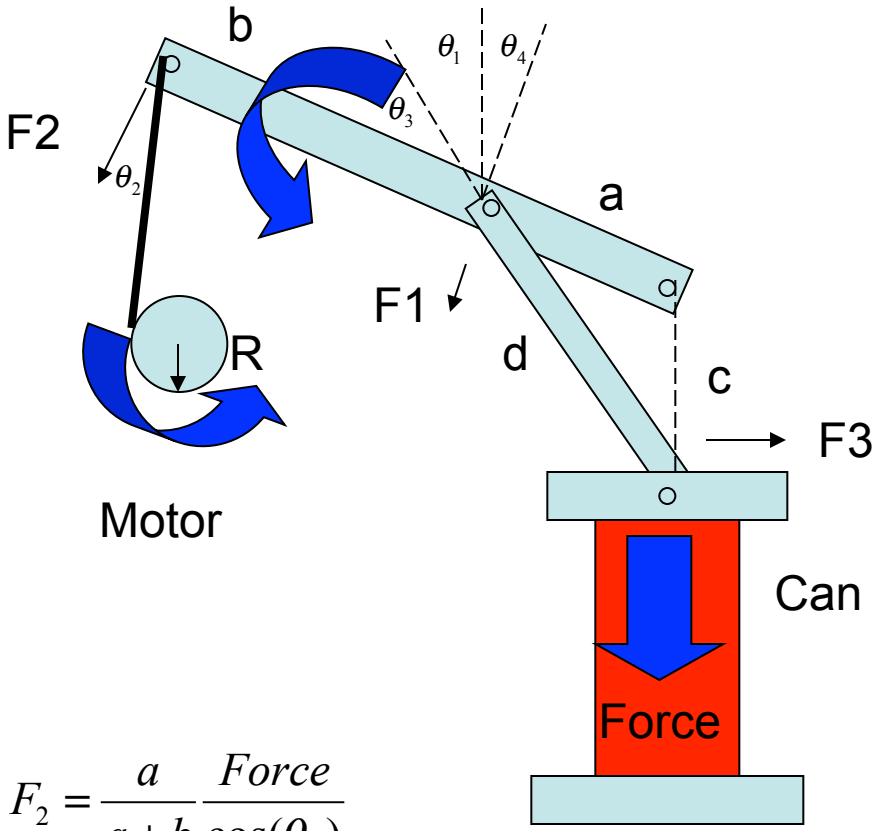

Experimental Results (high end)

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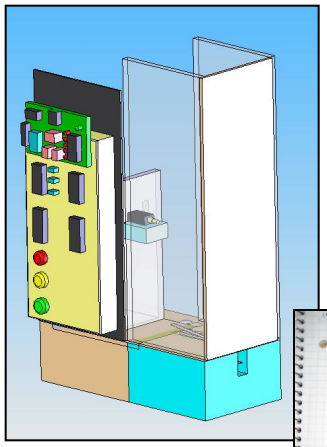
$$F_2 = \frac{a}{a+b}\frac{Force}{\cos(\theta_4)}$$

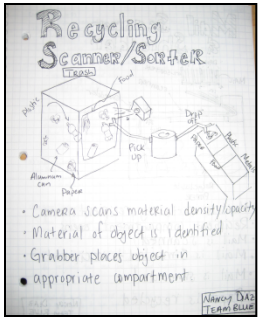
$$T_{Motor} = \frac{a}{a+b} R \frac{Force}{\cos(\theta_4)\cos(\theta_2)}$$

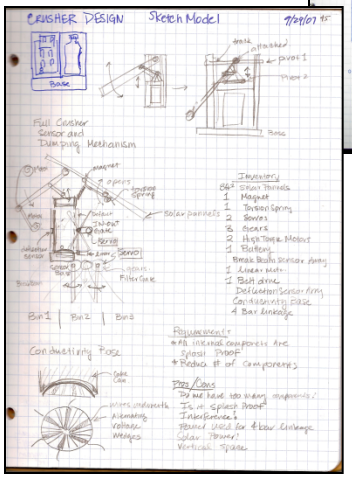
→ Torque ~ 2.17N*m

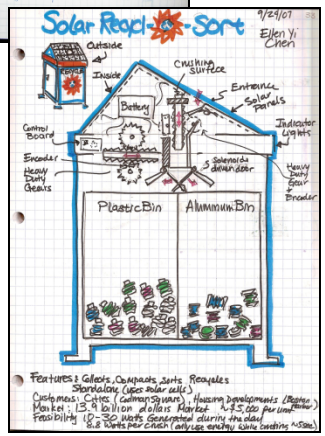
for dimensions: a = 0.15, b = 0.4, d = 0.2, R = 0.01, Force = 540N, Theta1 = 45deg, Theta2 = 20deg

Design Alternatives Explored









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Acknowledgements

Li, Vivian. Boston Harbor Association. Phone interview. 2 Oct 2007.
Loesch, Cynthia. Codman Square. Email and interview. 2 Oct 2007.