Objective

Conventional shopping carts fail to allow easy/safe access to the bottom rack for the loading/unloading of items

**Need for Product:**
- Improper bending of the back trying to access the bottom rack causes injuries

**Customer Requirements:**
- Capacity of Cart
- Maneuverability
- Ease of Access
- Durability
- Capacity of bottom rack
- Compactability

**Constraints:**
- Size/Nestability
- Manufacturing Processes
- Compactability

**Physical of Task:**

\[
T = F \cdot d \\
V = r \cdot w \\
T_1 \cdot w_1 = T_2 \cdot w_2
\]

Engineering Characteristics:
- Weight
- Cart Capacity
- Stackability
- Material Strength
- Drop Test Durability
- Lift Force
- Dimensional Size

Market Size:
According to the 2010 census along with our survey analysis, approximately 3 million people shop daily in the DC/Baltimore area. Research also showed that majority of back issues begin at the age of 35. The recorded population in the area over the age of 35 is 1.8 million people.

Design

**Operation:**
- To raise the platform, rotate the handle that rotates the two pinion gears
- The pinion gears drive the racks. The rotational motion is translated to linear motion with the use of a rack and pinion system
- The platform is attached to the bottom of the racks
- User places item on the fully raised platform and reverses the direction of rotation of the handle to lower the platform

**CR Satisfactions:**
- Does not decrease the capacity of the shopping cart basket or bottom rack
- Capability of attaching to a variety of different shopping carts
- Significantly reduces the amount of bending of lower back
- Improves ease of access of the bottom rack

**Trade-offs:**
- Shifts the center of gravity of the entire cart when loaded

Prototype and Testing

**Prototype made from available materials**
(Aluminum and steel)
- Aluminum: Frame, Platform
- Steel: Rack, Pinion, Shaft, Handle

**Testing:**
1. Amount of time required to fully raise/fully lower the platform.
   - (11.01 seconds assuming 60 rpm)
2. Loading the platform with a load of 26 lbs (average weight of a case of water)
3. Amount of force needed to raise/lower an unloaded platform
Future testing will incorporate dropping loads from various heights onto the platform to test impact loads.
Calculations showed that introducing another gear for mechanical advantage did not significantly improve importance

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Test Results and Future Work

Design Process Summary:
- Identified the need for a product that prevents lower back injuries when shopping and placing items on the bottom rack of a shopping cart
- Surveyed shoppers and found that many already have back injuries/problems which would indicate interest in the ShopLifter
- Generated and evaluated concepts
- Performed FEA analysis on platform/rack
- Fabricated the ShopLifter to test the final design

**Recommendations:**
- Select material that is lightweight and durable to be used throughout the ShopLifter
- Investigate methods for getting products completely off the platform and onto the bottom rack
- Design the ShopLifter to be able to be mounted to a variety of shopping cart sizes and types

**Reflection:**
- Concept Generation allowed the team to solve a problem in a variety of different ways
- Prototyping allowed for refinement of design ideas

Sudip Bhattacharjee, Brendan Dempsey, Nathan Elencweig, Alex Kim, Will Nussman