Background

Redesigning Maquet’s operating room light suspension system

Current Problem:
- Light mobility
- Drift
- Dead zones
- Maintenance
# Project Specification

<table>
<thead>
<tr>
<th>Must Do</th>
<th>Should Do</th>
<th>Would be nice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Support a Load of 20 kg</td>
<td>Spin Range 420°</td>
<td>Multiple Loads</td>
</tr>
<tr>
<td>Vertical positioning Force $\leq 16.5$ N</td>
<td>Smooth Motion</td>
<td>Meet IEC Medical Standards IEC 60601</td>
</tr>
<tr>
<td>Articulation Force $\leq 25$ N</td>
<td>Small Gaps (IP44 rating)</td>
<td></td>
</tr>
<tr>
<td>Vertical Range 1-2.1 m</td>
<td>MFGT cost $1940.00</td>
<td></td>
</tr>
<tr>
<td>Max Radial Distance 2.5 m</td>
<td>Surfaces, Corners &amp; Edges</td>
<td></td>
</tr>
<tr>
<td>No Dead Zones</td>
<td>No Surface Liquid Pooling</td>
<td></td>
</tr>
</tbody>
</table>
Our Design Solution
- Delrin bushings
- Grease
- Shaft within a shaft
- Concise
- Rigid
Gear 1 is fixed (connected to upper arm)

Arm rotates freely
Fabrication

- Fabricated
  - Frame, Arms, Laser cut parts - Transfer Flow
- Purchased
  - Bearings, Gears, Fasteners (Delrin Bushings < Bearings)
Fabrication Difficulties

- Tolerances
- Light attachment
- Joints
- Springs
Testing

- Loads
- Articulation Forces
- Vertical Range
- Horizontal Range
- Braking System
## Total Cost Excluding Labor - Last semester.

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw material</td>
<td>$772</td>
</tr>
<tr>
<td>Purchased parts</td>
<td>$825</td>
</tr>
<tr>
<td>Outside of Manufacturing</td>
<td>$1,210</td>
</tr>
<tr>
<td>shipping</td>
<td>$260</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$3,067</strong></td>
</tr>
</tbody>
</table>
Total Project Cost

**Total Budget**

<table>
<thead>
<tr>
<th>Component</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Raw material</td>
<td>$750.57</td>
</tr>
<tr>
<td>Fabrication</td>
<td>$515.63</td>
</tr>
<tr>
<td>Frame</td>
<td>$250</td>
</tr>
<tr>
<td>Hardware</td>
<td>$72.07</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$1516.2</strong></td>
</tr>
</tbody>
</table>
Details Budget:

Material = $ 750
- Spring       $203
- Bearing     $105.68
- Gear         $211.02

Free Donation
- Transfer Flow
  - Material $ 78
  - Labor $ 115

- Scotty Vanni
Fabrication:

**Step 1:**
Fold spring 180° at desired length and cut. Cut shorter than needed by about one-half the coil body diameter.

**Step 2:**
Across from cut end, bend last coil up at 45° angle. To form double loop, bend last two coils up 45°. DO NOT USE HEAT.

**Step 3:**
Twist cut end of loop into center of coil body. May require pliers. May have to twist past center to allow new loop to flex back.

**Step 4:**
Cut end of newly formed loop to obtain gap, if necessary, for mounting.
Reflection

❖ Budget
❖ Springs
❖ Suspension Joint
❖ Upper Control Arm
In Conclusion...

QUESTIONS?