MechE United: Laptop Bed Buddy

Objective

- Laptops serve as a main source of entertainment for college students who have limited space in their dorm rooms for TV’s and other furniture, yet students often experience discomfort when using their laptops in bed.

Customer Requirements

- Sturdy
- Adjustable
- Easy to assemble
- Lightweight
- Compact when stored

Market Size

- Over 100,000 undergraduate students in the Washington, D.C. and Baltimore area.

Constraints

- Sturdy to hold any laptop size
- Attach to a dorm bed of any size
- Cause no permanent damage
- Safe during installation and use
- Light enough for a person to lift

Concept Generation

- Similar products exist, but none can suspend the laptop horizontally above the user’s head.
- The HOQ output 5 design criteria: Max Moment, Design Complexity, Maximum Bending, Stress of Supporting Arm, Tray Area, and Fatigue of Joints.
- The AHP was used to select the final design concept, similar to Design Choice 3. This concept was chosen because of its strength and stability, which fulfilled the design criteria specifications.

Product Design Summary

- Identified a need for a laptop holder in bed.
- Used AHP to determine final concept.
- Performed FEA on CAD model of final concept.
- Built and prototyped final concept.

Operation of Product

- User can use laptop comfortably lying down or sitting up in bed.

Sacrificed Customer Requirements

- Sturdy: built to withstand 20 lbs.
- Adjustable: can be positioned in all degrees of freedom
- Stored Volume: 29.5” x 20” x 42”

Satisfied Customer Requirements

- Sturdy: built to withstand 20 lbs.
- Adjustable: can be positioned in all degrees of freedom
- Stored Volume: 29.5” x 20” x 42”

Testing Procedure

- Prototype design is very close to the ideal design.
- Each subassembly was analyzed separately.
- A 20lb force load was applied to replicate the maximum weight of a laptop, the clamps, and the ball and socket.

<table>
<thead>
<tr>
<th>Sub Assembly</th>
<th>Failure Index</th>
<th>Safety Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>0.18</td>
<td>5.7</td>
</tr>
<tr>
<td>Support</td>
<td>0.39</td>
<td>2.56</td>
</tr>
<tr>
<td>Clamp</td>
<td>0.11</td>
<td>9.09</td>
</tr>
</tbody>
</table>

Process Reflection

- Concept generation allowed team to brainstorm a large variety of design options.
- CAD and FEA were beneficial for visualizing the movement, determining stress, and aiding in building.

Future Design

- Design a base with smaller envelope volume.
- Design clamps with improved laptop cooling solution and to hold broader range of laptop sizes.

Market Size

- Over 100,000 undergraduate students in the Washington, D.C. and Baltimore area.

Customer Requirements

- Sturdy
- Adjustable
- Easy to assemble
- Lightweight
- Compact when stored

Test Results and Future Work

- Identified a need for a laptop holder in bed.
- Used AHP to determine final concept.
- Performed FEA on CAD model of final concept.
- Built and prototyped final concept.

<table>
<thead>
<tr>
<th>Product Design Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identified a need for a laptop holder in bed.</td>
</tr>
<tr>
<td>Used AHP to determine final concept.</td>
</tr>
<tr>
<td>Performed FEA on CAD model of final concept.</td>
</tr>
<tr>
<td>Built and prototyped final concept.</td>
</tr>
</tbody>
</table>

CAD Assembly of Laptop Bed Buddy

Prototype and Testing

- Prototype design is very close to the ideal design.
- Each subassembly was analyzed separately.
- A 20lb force load was applied to replicate the maximum weight of a laptop, the clamps, and the ball and socket.

<table>
<thead>
<tr>
<th>Sub Assembly</th>
<th>Failure Index</th>
<th>Safety Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>0.18</td>
<td>5.7</td>
</tr>
<tr>
<td>Support</td>
<td>0.39</td>
<td>2.56</td>
</tr>
<tr>
<td>Clamp</td>
<td>0.11</td>
<td>9.09</td>
</tr>
</tbody>
</table>

Test Results and Future Work

- Identified a need for a laptop holder in bed.
- Used AHP to determine final concept.
- Performed FEA on CAD model of final concept.
- Built and prototyped final concept.

Process Reflection

- Concept generation allowed team to brainstorm a large variety of design options.
- CAD and FEA were beneficial for visualizing the movement, determining stress, and aiding in building.

Future Design

- Design a base with smaller envelope volume.
- Design clamps with improved laptop cooling solution and to hold broader range of laptop sizes.