Arterial Line Simulator

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Client: Mr. Mitchel Reuter
Overview of Presentation

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Problem Statement

- Want to simulate arterial line waveforms without use of manikins
- Current practice is to move the syringe plunger by hand
- Use in teaching labs
Background

- Arterial line monitoring is an invasive method of monitoring both heart rate and blood pressure through arterial waveforms
- Helpful for real time feedback about a patient’s cardiovascular system
- Not many accessible designs for practicing placing and reading the waveforms from this device
- We must create a device that can accurately and consistently produce an range of arterial waveforms

Figure 1: Examples of the various arterial waveforms [1]
Product Design Specifications

Our device must be:

- Be about the size of a vhs tape
- Have variable speeds 30-200 rpm
- Be able to replicate the various arterial waveforms
- Can be reusable and easily attached to a 10ml syringe
Design Idea 1: The Cam

Figure 3: The Cam design
Design Idea 1: The Cam

Advantages:

● Simple mechanism – fewer points of failure
● Range of use – swapping cams
● Cost – only one motor and one moving part

Disadvantages:

● Cam shape – manufacture multiple types
● Durability – swapping cams
Design Idea 2: The Piston

Figure 4: The Piston design
Design Idea 2: The Piston

Advantages:
- Simplistic Design
- Consistent - Same motion time and time again

Disadvantages:
- Multiple parts -> more points of failure
- Difficult to produce multiple waveforms
Design Idea 3: The Bolt

Figure 5: The Bolt design
Design Idea 3: The Bolt

Advantages:
- Durability - stable clamp
- Range of Use - all waveforms

Disadvantages:
- Consistency - slow motion of bolt
- Cost - bolt, motors, clamp
# Design Matrix

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Design 1: The Cam</th>
<th>Design 2: The Piston</th>
<th>Design 3: The Bolt</th>
</tr>
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<tbody>
<tr>
<td>Consistency (25)</td>
<td>5/5 * 25 = 25</td>
<td>5/5 * 25 = 25</td>
<td>4/5 * 25 = 20</td>
</tr>
<tr>
<td>Range of Use (25)</td>
<td>4/5 * 25 = 20</td>
<td>2/5 * 25 = 10</td>
<td>3/5 * 25 = 15</td>
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<tr>
<td>Ease of Use (20)</td>
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<td>5/5 * 20 = 20</td>
<td>4/5 * 20 = 16</td>
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<td>Ease of Fabrication (10)</td>
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<td>2/5 * 10 = 4</td>
<td>2/5 * 10 = 4</td>
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<tr>
<td>Safety (10)</td>
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<td>5/5 * 10 = 10</td>
<td>4/5 * 10 = 8</td>
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<tr>
<td>Durability (5)</td>
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<td>3/5 * 5 = 3</td>
<td>4/5 * 5 = 4</td>
</tr>
<tr>
<td>Cost (5)</td>
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<td>4/5 * 5 = 4</td>
<td>4/5 * 5 = 4</td>
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<tr>
<td>Total = 100</td>
<td>89 / 100</td>
<td>76 / 100</td>
<td>71 / 100</td>
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</table>
Future Work

- Calculate cam shape
- Determine what motor will be used
  - Use motor speed to determine diameter of cam
- Fabrication options
- Automate waveform controls
Acknowledgements

Mr. Mitchel Reuter

Dr. Melissa Skala

BME Department
References


