Manus
Modular Hand Attachment
Product Contract

Description
Arm prosthesis attachment that allows for better control of tools requiring fine motor dexterity

Market
73,500 upper limb, below elbow amputees in the US

Value Proposition
Low cost, Portable, Makes life easier
Regain independence in activities of daily living
# Product Contract

<table>
<thead>
<tr>
<th>User Needs</th>
<th>Product Attributes</th>
<th>Engineering Specification</th>
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</thead>
<tbody>
<tr>
<td>Versatility</td>
<td>Use a variety of different tools</td>
<td>10 tool attachments available</td>
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<tr>
<td>Easy to use</td>
<td>Simple attachment mechanism</td>
<td>First use takes under 1 min to swap tools</td>
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<tr>
<td>Affordable</td>
<td>Cost</td>
<td>&lt;$700</td>
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<tr>
<td>Portable</td>
<td>Weight of terminal device</td>
<td>Weight &lt; 150g (considerably lighter than prosthesis)</td>
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<tr>
<td>Can be worn all day</td>
<td>Comfort</td>
<td>User feedback is &gt;90% positive for comfort</td>
</tr>
<tr>
<td>Cosmesis</td>
<td>Aesthetic design</td>
<td>User feedback is &gt;90% positive for aesthetics</td>
</tr>
<tr>
<td>Changing tools is quick</td>
<td>Quick-change mechanism</td>
<td>Time to swap tools &lt; 30s after first use</td>
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User Persona

Dominic
Dominant hand amputee and former construction worker

Needs and Concerns
- Wants to do able to do tasks such as eating, cooking, and writing easily and independently
- Prefers using his dominant arm
- Frustrated by the lack of options for simple, inexpensive tools
Dominic attaches sleeve to prosthesis
Takes out the multitool bag
Slides out the tool of his choice
Slides tool into the hand attachment
Uses the tool to complete simple everyday tasks
Slides the tool back out
Design Details
High-Level Assembly

Prosthetic Interface

Tool Change Mechanism

Tool
Prosthetic Interface
#1 - Clamp Wrist Attachment

*Rubber liner*
#2 - Fabric Tightening Brace Attachment

**Off the Shelf Sleeve**

**Tensioning Strings**

**Tightening Mechanism**
Tool Change Mechanism
#1 - Ball Detent

**Tool Side**

**Prosthetic Side**

*Hole to catch ball*
#1 - Ball Detent

Locked

Compression Spring

Unlocked
#1 - Ball Detent
#2 - Snap in/Slide out

**Prosthetic-Side**

- Retaining Clips

**Tool-Side**

- Alignment Magnets
#2 - Snap in/Slide out
#3 - Positive Latch
Further Exploration
2nd Degree of Freedom

Model for advanced utensil tool

- Users need to articulate the utensil along several degrees of freedom for unencumbered, independent use
- Coupling thin riveted plates and a Hirth joint under spring tension allows for this necessary motion
Soft & Hard Carrier Cases

**Soft Leather Carrying Case**
- Simple roll-up case
- Designed for discreetness & portability

**Hard Shell Carrying Case**
- Panels flare out to reveal tool
- Focus on one-handed operation
Appendix
Cost Analysis

Value-Driven

Similar products:
Parkinson’s spoon (Amazon)
• Enabling usage of utensils with dominant hand
• $278 (link)

Prosthetic hooks (Used, Ebay)
• Similar market, similar complexity
• $450 for two (link)

Procuff
• Similar product, different user/focus
• $800 (link)

Costs
Order of Magnitude cost analysis

Assumption (mockup-like, 50k units, over-estimate):
• 2 hours of machining: $200
• Wrist brace: $20
• Spring plunger mechanism: $10
• R&D time (20 people-years): $80
• Tool set: $20
• Attachment bag: $15

Total: $345 estimated
At scale could be reduced to ~$300 (Reduction in R&D time/unit, better manufacturing methods, bulk purchasing of COTS items)
Stationary Hook Interface