Detailed Design Project Memo

Conceptual Design Identification  
Hanging Clothes

Summary of the Recommended Detailed Design Option

The recommended option is designed to be simple while meeting all the constraints. The design uses a simple mechanism where the hook pulls the arms down and the pin in the middle of the arms allows them to flatten and hang clothes.

Context and Motivation

The expansion mechanism is the main structural design detail in the overall design. Since the foci of the conceptual design are usability and recyclability, this is a very important decision to make. How the hanger expands determines its usability because if the hanger does not expand properly when a piece of clothing is put on, the hanger will be hard to use. On the other hand, the main objective of this design detail is to expand while a piece of clothing drops on and to afford heavier coats, and all material is restricted to one kind of thermoplastic, therefore it’s important to make the hanger with the least amount of material and afford the most weight.

Requirements

Objective:
To design a mechanism that will allow the hanger to expand upon dropping of a piece of clothing.

Constraints:
1. Must be easy to use, better if the hanger expands when a light piece of clothing drops on.
2. All components must use the same material—thermoplastics.
3. Must fit garments of average sizes for adults.

Metrics and Criteria:
1. Better capacity and durability are preferred.
2. Lower cost is better.
3. The easier to manufacture, the better.

Alternatives Considered

#1: “W” hanger (Please refer to Figure 1 in appendices)

The two supporting rods are connected to the two outer arms, and the angle between them is adjustable by pulling the hook up and down.

When a piece of clothing drops, it will push the hook down and because the material is not elastic, it will push the whole hanger open to the expanded position on the right.

#2: Curve Hanger (Please refer to Figure 2 in appendices)

This design makes use of a similar expanding mechanism as option #1 but with a different shape. The curved shape is inspired directly from an inverted umbrella.

#3: Hollow Compartment Hanger (Please refer to Figure 3 in appendices)

This design uses a pin to join the two arms together and uses a hollow compartment to store the arms when the hanger is closed. The hook is connected to the pin. In the left figure, the pin and the arms
are in the compartment behind the hook. The hollow compartment has an opening at the front, allowing the hook to slide.

When a piece of clothing is dropped, the hook will drop due to gravity and the clothing weight, to the point where the pin can stretch and flatten the two arms. The hook shape at the end of the arms ensures that the clothing will not fall even if it might be big for the hanger.

Constraints Analysis:
1. All the candidates make use of gravity force to help light clothes pull and expand the hanger.
2. The pins, arms, supports, and main shaft are all made of one kind of thermoplastic, as required. No extra material is needed in the design.
3. The dimensions are designed to be 45cm across for all candidates. According to the statistics from a professional hanger company and in practice, 45cm is a suitable size for garments of average adults [1]. If the clothes are too small, it will hang without fully expanding the hanger, as the max shoulder width of the clothing restricts the hanger from fully expansion. If the clothes are too big, the hanger will catch them above the shoulders where the width is smaller.

Detailed Justification of Recommendation against Alternatives

To begin with, from the criteria specified in the conceptual design and design brief, a narrowed set of criteria is produced specifically to this detailed design decision. For example, because the whole hanger is made of only one material, there is no need to worry about the health problems associated with the expansion mechanism as long as it does not shoot parts out or have very sharp edges. And the refined set of criteria is listed in Chart 1. They are determined to have the same weights because they are already narrowed to the main foci of the design.

Next, corresponding metrics must be determined. Since the material is chosen, lengths of material used are estimated and used to compare the material costs between different mechanisms. Because there are other manufacturing costs and the manufacturers are listed as one of the stakeholders, ease of manufacturing is determined by how many different parts are there and if they are curved or of a different shape. Durability is measured by how many joints are used because the joints are usually the first to break. Ease to use is determined by how many parts and their weights are involved in the mechanism because the lighter the hanger itself is, the easier for the clothes to pull the hook.

Detailed analysis:
1. Durability: Candidate one is the least durable because it makes use of four joints and six arms compared to two joints and one joint and two arms in the other designs.
2. Cost: After measuring and estimating (because candidate #2 has a circular part), candidate #2 costs the most and candidate #3 costs the least in terms of materials.
3. Ease to use: Candidate #3 involves fewer parts and uses the least amount of material compared to the other two.
4. Ease to manufacture and assemble: Although candidate #1 uses the most parts and joints, the six arms are straight and of the same size, therefore in terms of manufacturing it is better than candidate #2 with curved arms. At the same time, candidate #3 has a hollow compartment. Besides that, the two arms and main shaft are of the same size. Therefore it is of the same level with candidate #1.

Candidate #3 is the best among the three with a positive score comparing to the reference.
References


Reference Designs:


Appendices

Figure Legend:
1: Hook  
2: Plastic pin that joins two arms  
3: Main shaft
4: Supporting rod  
5: Arms
6: Hollow compartment that fits two arms with an opening that allows the hook to slide

Figure 1: Candidate Design option #1 Closed (left) and Expanded (right) view

Figure 2: Candidate Design option #2 Expanded (left) and Closed (right) view
### Chart 1: Pugh Chart

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<th>Candidate #3</th>
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(Only one passes)

Figure 3: Candidate Design option #3 Closed (left) and Expanded (right) view