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An Expanded Ideation Metric for Assessing the Variety of Design Ideas

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Background

Key Definitions

- Ideation is the process of generating conceptual ideas early in the design process
- Ideation metrics analyze qualities of individual ideas (e.g., novelty) and of sets of ideas (e.g. quantity, variety)
- Variety is a measure of the explored solution space during ideation and/or the level of internal differentiations within a set of ideas

Prior Research

- Shah et al. (2003) developed a variety metric based on functional breakdown and genealogical trees
- Nelson et al. (2009) refined the metric to focus on differentiations between ideas
- Variety metrics should be validated on more elaborate, real life sets of ideas (Verhaegen et al., 2013)

Research Questions

When applying the Shah et al. (2003) method to real datasets:

1. How do you classify ideas that are functionally identical?
2. How do you classify ideas that offer multiple solutions to a function?
3. How to you classify ideas that don't fit the expected functional breakdown, yet still solve the problem?

Our Approach

Data Collection

Five undergrads given 20 minutes to generate design ideas for a design problem

Analysis

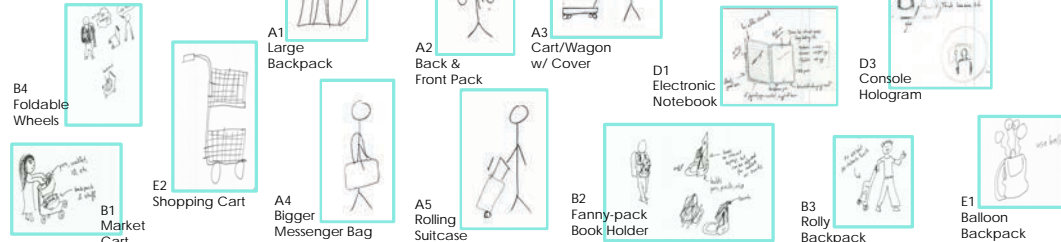Prior to looking at ideas, break down problem into functional requirements

Classify ideas based on solution to each function in four levels: Physical Principle, Working Principle, Embodiment, Detail

Make a tree for each function

Calculate variety metric

Design Problem

Design a way for college students to carry their heavy school supplies.

Design Ideas

B4 Foldable Wheels
B1 Market Cart
E2 Shopping Cart
A1 Large Backpack
A2 Back & Front Pack
A3 Cart/Wagon w/ Cover
A4 Bigger Messenger Bag
A5 Rolling Suitcase
B2 Fanny-pack Book Holder
D1 Electronic Notebook
C1 Shock Absorber Backpack
D2 "Mini-Packer"
D3 Console Hologram
B3 Rolly Backpack
E1 Balloon Backpack

Expanded Variety Metric

1. Identical Ideas – Add a fifth classification level ("Individual Ideas") for ideas that are functionally identical
   - Not all ideas will differ at the Detail level
   - Identical ideas will decrease the variety score
2. Combination Ideas – Break up into the different solutions and classify each as its own idea
   - Each sub-idea, if different from other ideas, will add to the variety score
3. Paradigm-modifying ideas – Add an additional category that exists across functions
   - Equivalent to a differentiation at the highest level

Combination Ideas

Ideas that combine two or more solutions for a function

- Each solution is broken up into its own place in the tree
- Each combo has potential to add variety like any single idea
- A combo idea doesn't have to be a combo for all functions

Example: Balloon Backpack (E1)

- Balloon solution bears the load differently than the backpack solution

Paradigm-Modifying Ideas

Paradigm-Preserving (P-P) Ideas solve the problem using expected functions

Paradigm-Modifying (P-M) Ideas eliminate the need to directly meet the functional requirement

- P-M ideas are valid solutions to the problem statement despite sidestepping the functional requirement
- Offer more variety potential

Example: Console Hologram (D3)

- There is no load to be carried
- There is no transportation of supplies needed

Future Work

Applications to design courses

Variety should be assessed between ideation and Pugh chart comparison / final idea selection

Variety trees can be used to identify areas of the solution space that students aren't exploring

Variety Trees

Function 1: Bear Load

Paradigm Preserving | Paradigm Modifying | Doesn't Address Function

Physical Principle / Working Principle / Embodiment / Detail / Individual Ideas

Function 2: Transport Supplies

Combination Idea (blue)

Identical Ideas

Variety Metric

Weight		Branch Differentiations
10	x	2
5	x	2
2	x	4
1	x	3

$\frac{41}{20} = 2.05$

Total Concepts – 1 (21–1)

Weight		Branch Differentiations
10	x	1
5	x	1
2	x	2
1	x	2

$\frac{21}{17} = 1.24$

Total Concepts – 1 (18–1)

References

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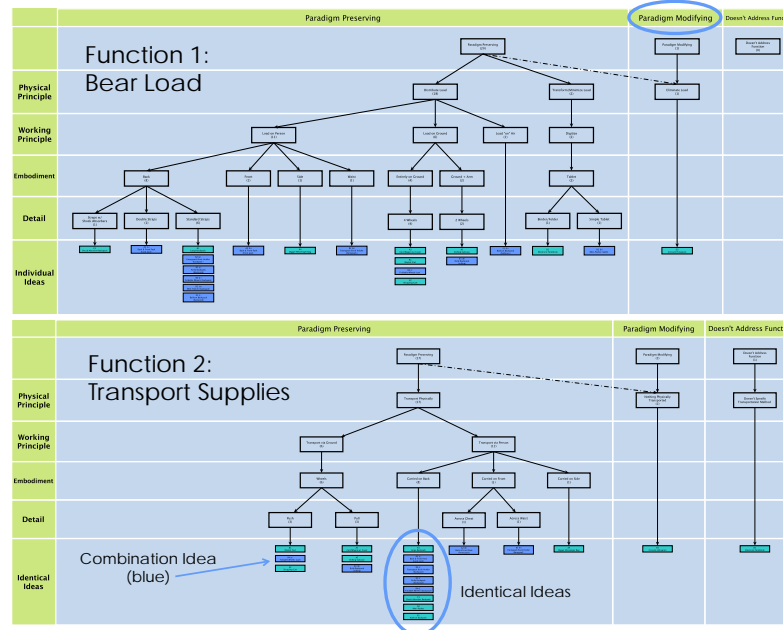
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