Generative AI for Medical Device Design

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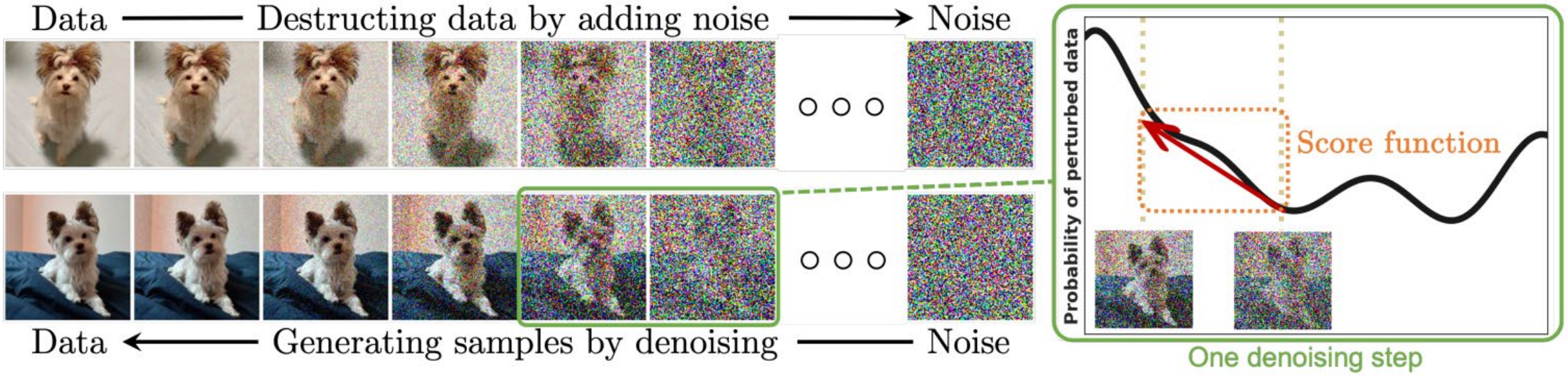
How does image generative AI work?



“Diffusion models smoothly perturb data by adding noise, then reverse this process to generate new data from noise. Each denoising step in the reverse process typically requires estimating the score function…which is a gradient pointing to the directions of data with higher likelihood and less noise.”

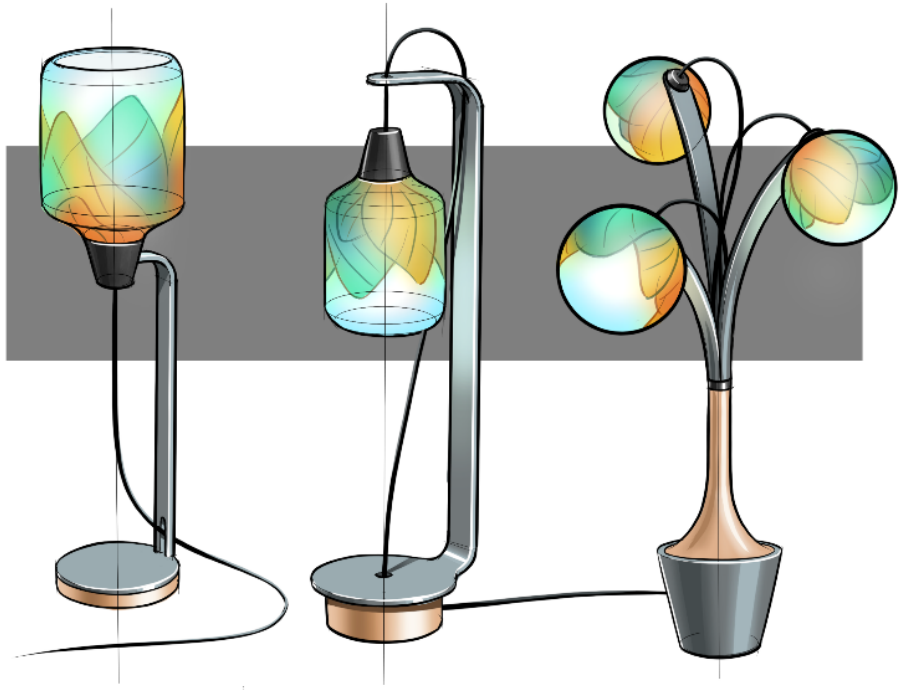
Ling Yang, Zhilong Zhang, Yang Song, Shenda Hong, Runsheng Xu, Yue Zhao, Wentao Zhang, Bin Cui, and Ming-Hsuan Yang. 2023. Diffusion Models: A Comprehensive Survey of Methods and Applications. 1, 1 (October 2023), 49 pages. https://doi.org/10.1145/3626235

How can AI be used in product design?

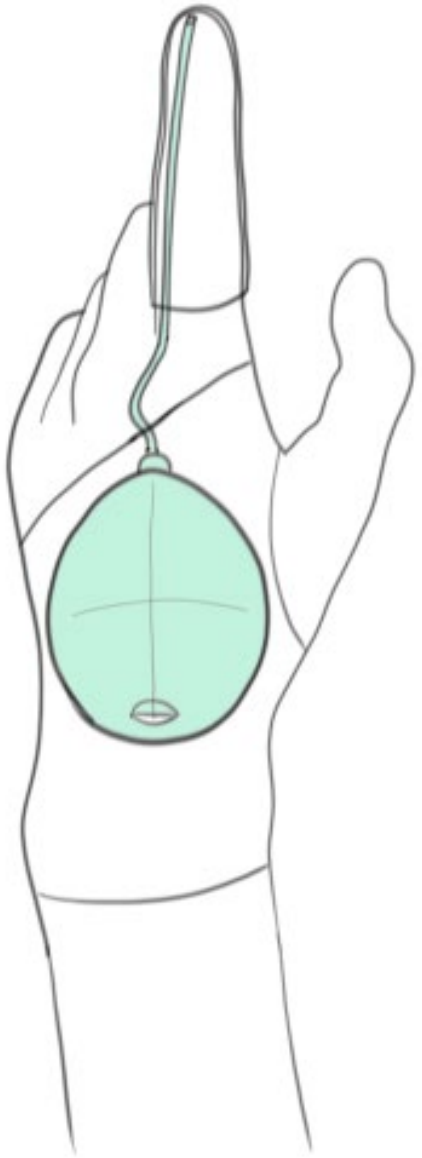
Midjourney V3 Output for Inspiration

text prompt: Light fixture lighting a brilliant, elegant light and airy crystalline patterns of light dancing photorealistic detailed plants greenery daytime bright modern beautiful balcony patio trees natural colors outdoors

Product Designer's Illustration



Images courtesy of Caterina Rizzoni of Kaleidoscope



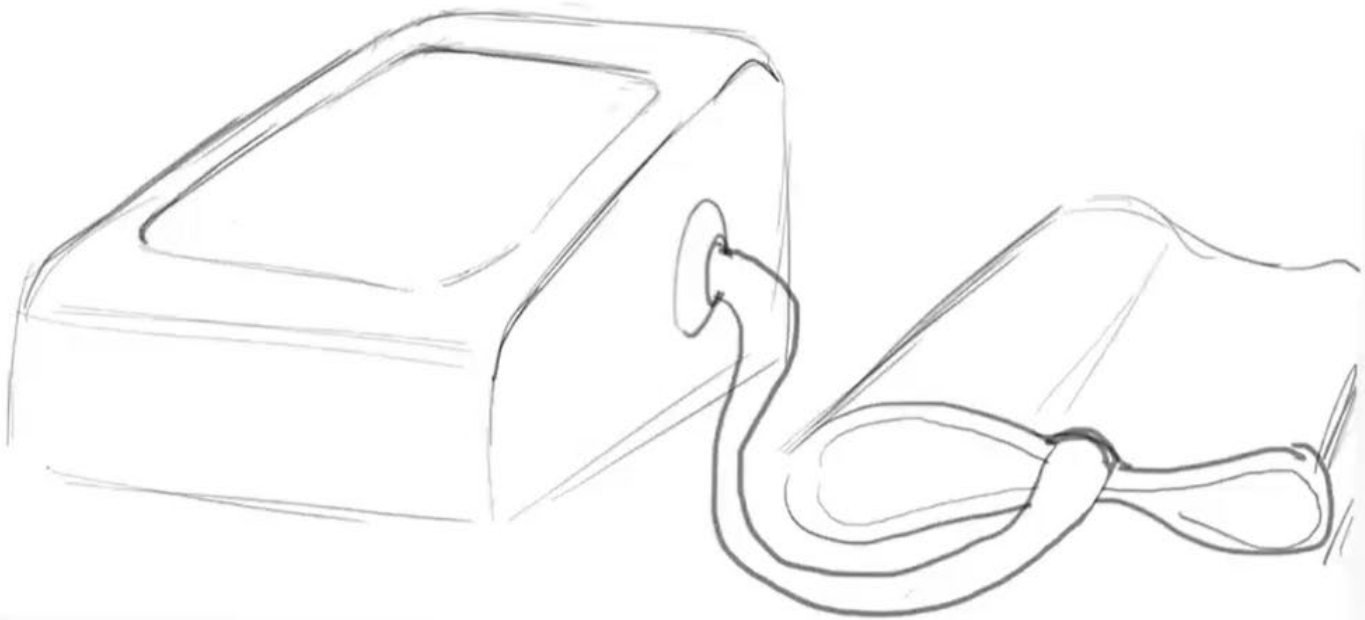
My drawing

Vizcom output
(vizcom.ai)

app.vizcom.ai/s2r/drawing/71c0be48-0e57-4978-92ba-a1976db1f4db

Files / Untitled

Export



Create

AI-driven visualization tool for quick product variations, sketches, and renderings.

Prompt

blood pressure monitore medical device

Mode

Render
For rendering sketches and line drawings

Refine
For refining or iterating on rendered images

Render style

Vizcom General

Drawing influence 100%

Number of images

1 4

Generate

Cancel Confirm

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Render style

Vizcom General

Drawing influence 65%

Number of images

1 4

Generate


Files / Untitled
Export
Layers
Layer 5 N 100%
blood pressure m... N 100%
Untitled - 2023-0... N 100%
Layer 1 N 100%
Background N 100%

Cancel Confirm

Create

AI-driven visualization tool for quick product variations, sketches, and renderings.

Prompt

blood pressure monitore medical device, blue fabric cuff

Mode

Render
For rendering sketches and line drawings

Refine
For refining or iterating on rendered images

Drawing influence 50%

Number of images

1 4

Generate

Cancel Confirm

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Prompt

blood pressure monitore medical device, blue fabric cuff

Mode

Render
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Refine
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Drawing influence 35%

Number of images

1 4

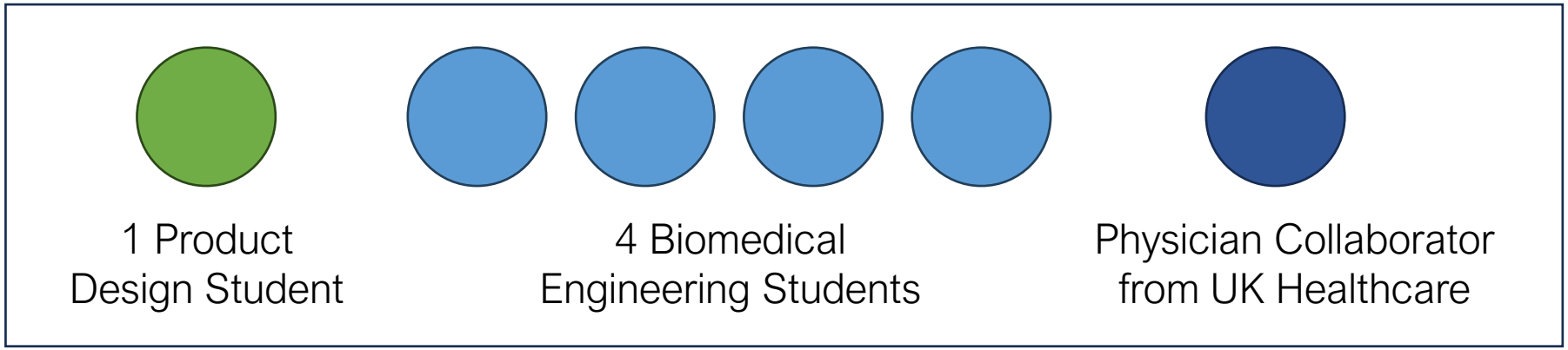
Generate

Educational Context

- Collaborative course:
  - Capstone course for biomedical engineering students (BME 420 taught by Dr. Davis Ferriell)
  - 3rd year studio course for product design students

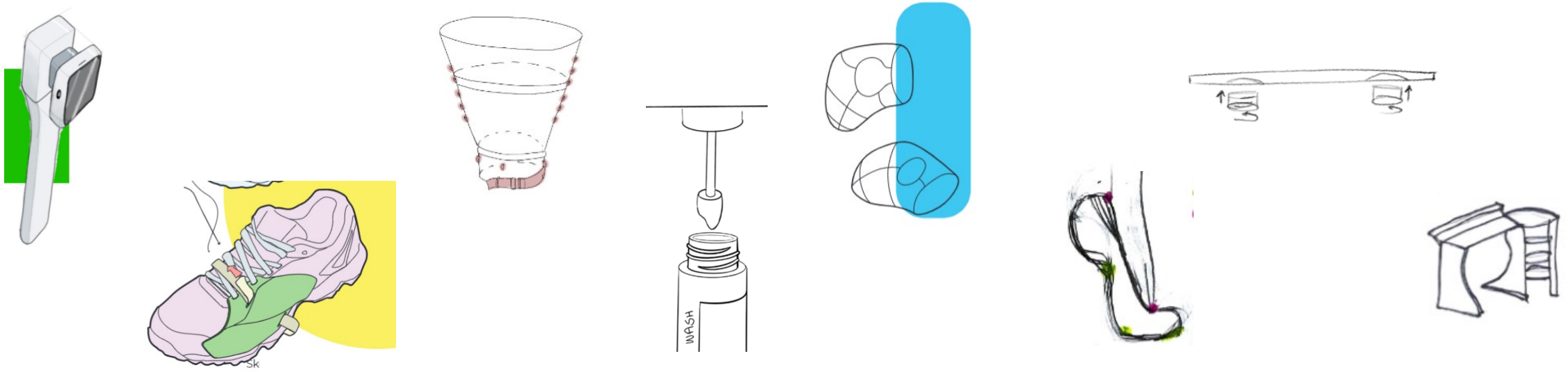
- Student teams identify unmet clinical needs and design solutions

9 Teams



How we are using Vizcom in the course

- Brainstorming and concept generation phase
- Design students will brainstorm many ideas through sketching and low-fidelity prototyping
- Sketching is a way to work out details and communicate design ideas to others



Research Questions

- Does Vizcom help the students develop concepts more quickly?
- Does Vizcom help the product design students communicate their ideas more clearly to their engineering teammates and clinical stakeholders?
- Does Vizcom help the students broaden their thinking and come up with ideas they would not have thought of otherwise?
- Does Vizcom play any sort of negative role, for example, causing students to rush ahead without thinking through alternatives and miss out on a better design direction?

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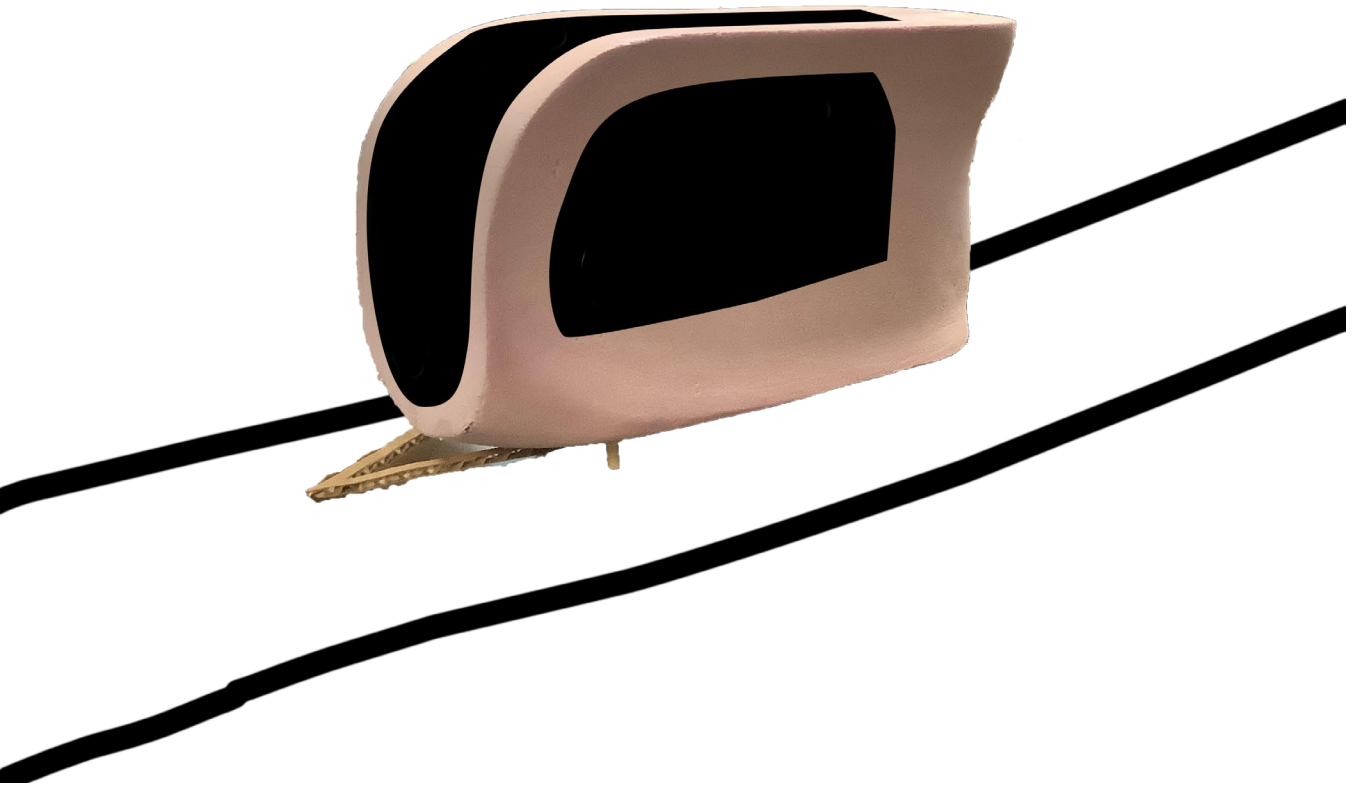

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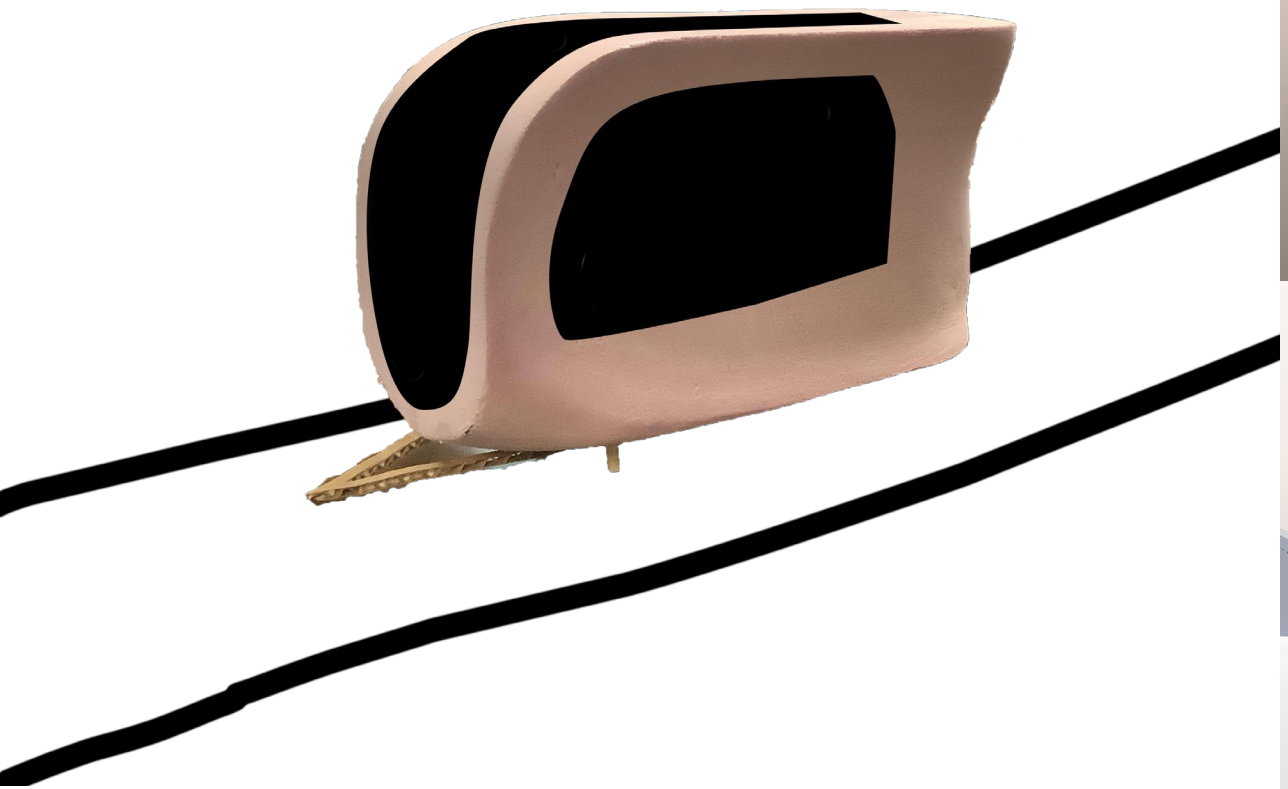

Data Collection Methods

Each product design student must create illustrations of 5 – 10 medical device concepts based on their team's identified need statements.

- How many of the illustrations can be successfully enhanced by incorporating Vizcom?
- How many of the concepts illustrated with Vizcom will be further iterated on? (vs. missing out on alternatives)
- Compare student work that uses Vizcom vs. students' baseline sketching level without it

Ethical Concerns

- Theft from artists and photographers whose work is used in training datasets without permission or compensation
- Poor wages and working conditions for annotators
- Outputs can be biased and reproduce stereotypes when depicting humans
- AI itself can be copying

Example of AI Copying

Image generated by Stable Diffusion

Image found in LAION-Aesthetics v2 6+ dataset

G. Somepalli, V. Singla, M. Goldblum, J. Geiping, and T. Goldstein, “Diffusion Art or Digital Forgery? Investigating Data Replication in Diffusion Models,” in *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*, 2023, pp. 6048–6058.

Concluding Questions

How can we teach students to use generative AI to become better designers?

How will generative AI change the skills that are considered fundamental in product design?

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