

MemoVis

ACM Transactions on
Computer-Human Interaction



A GenAI-Powered Tool for Creating Companion Reference Images for 3D Design Feedback



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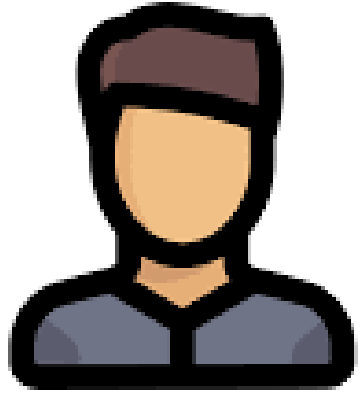


UC San Diego
JACOBS SCHOOL OF ENGINEERING
Computer Science and Engineering

UC San Diego
THE DESIGN LAB



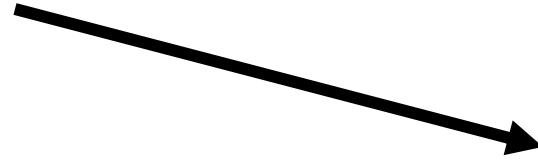
Asynchronous Feedback in 3D Design Review Workflows



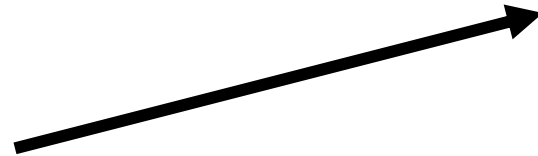
Collaborators



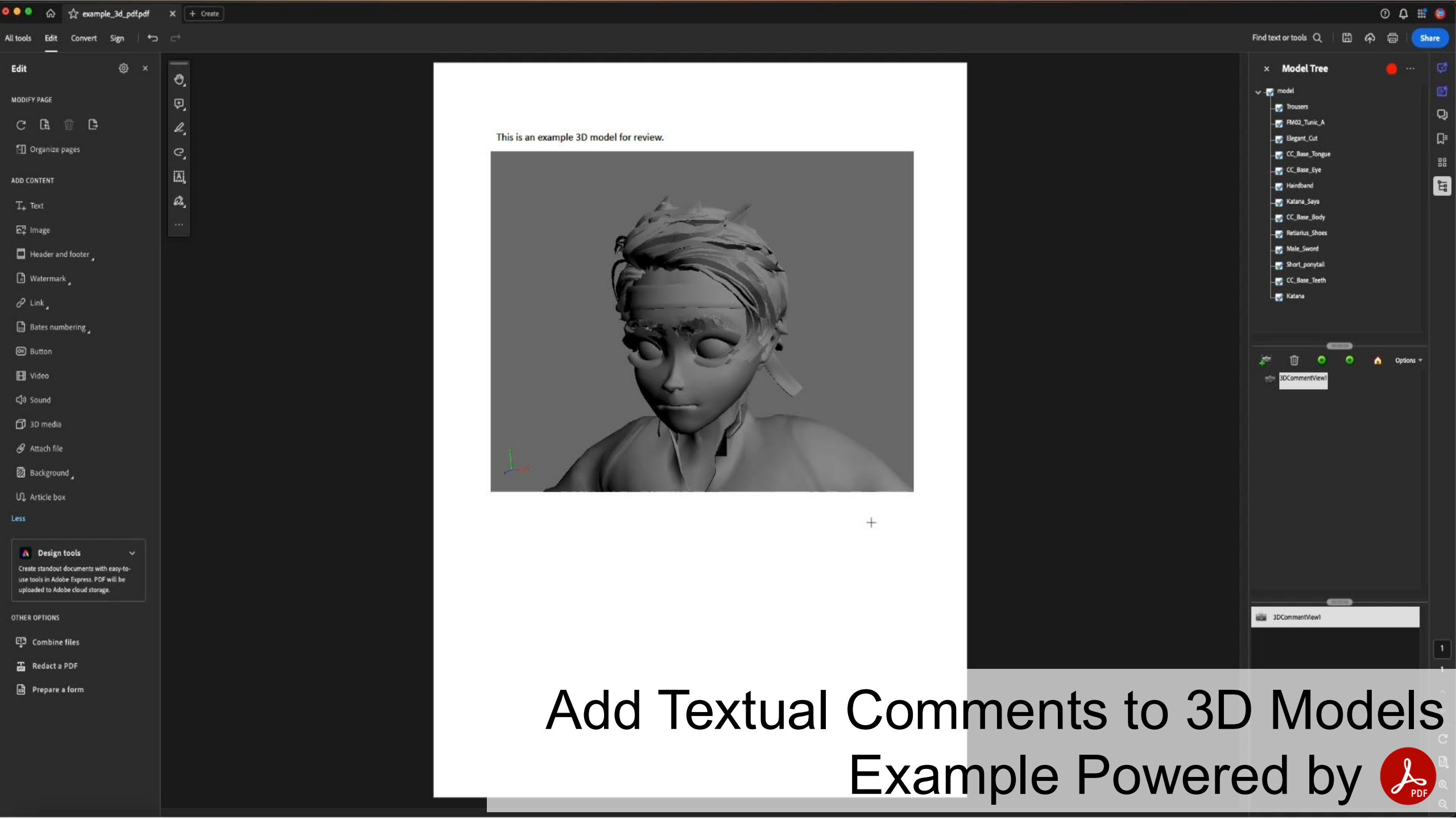
- Review the design
- Highlight issues
- Propose changes



Clients



3D Design



This is an example 3D model for review.



Model Tree

- model
 - Trousers
 - FM02_Tunic_A
 - Elegant_Cut
 - CC_Base_Tongue
 - CC_Base_Eye
 - Hairband
 - Katana_Saya
 - CC_Base_Body
 - Retliarius_Shoes
 - Male_Sword
 - Short_ponytail
 - CC_Base_Teeth
 - Katana

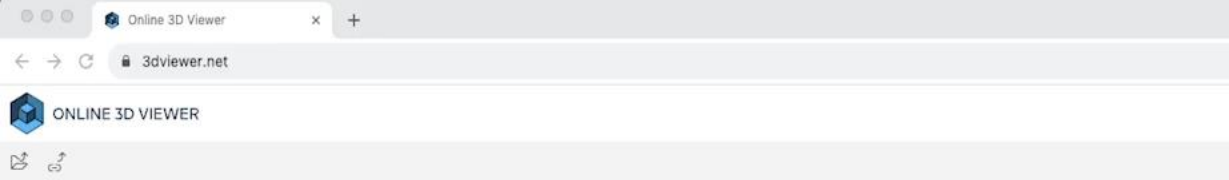
3DCommentView1

3DCommentView1

Add Textual Comments to 3D Models

Example Powered by





Load & Explore the 3D Model

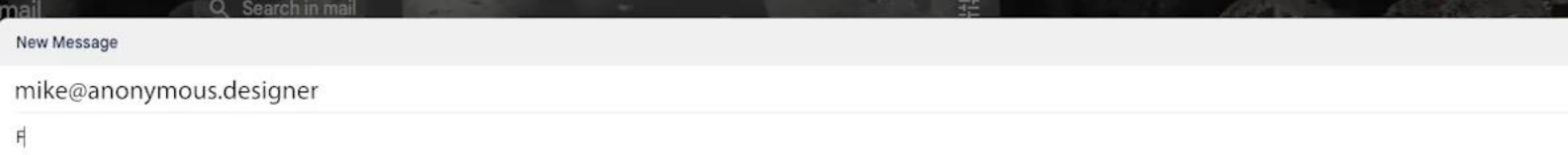


ONLINE 3D VIEWER

Drag and drop 3D models here.

Check an example file:

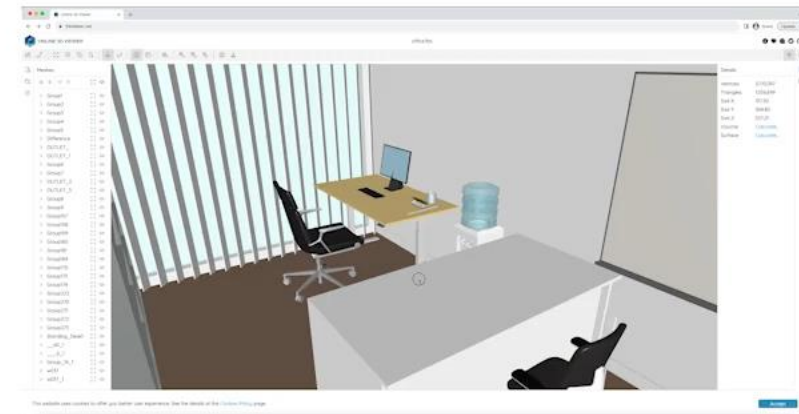
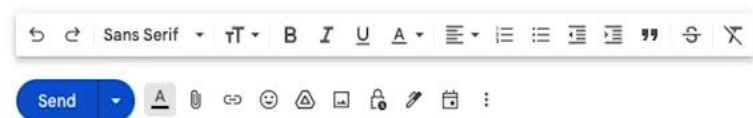
obj	3ds	stl	ply	gltf	off
3dm	fbx	dae	wrl	3mf	amf
ifc	brep	step	iges	fcstd	bim

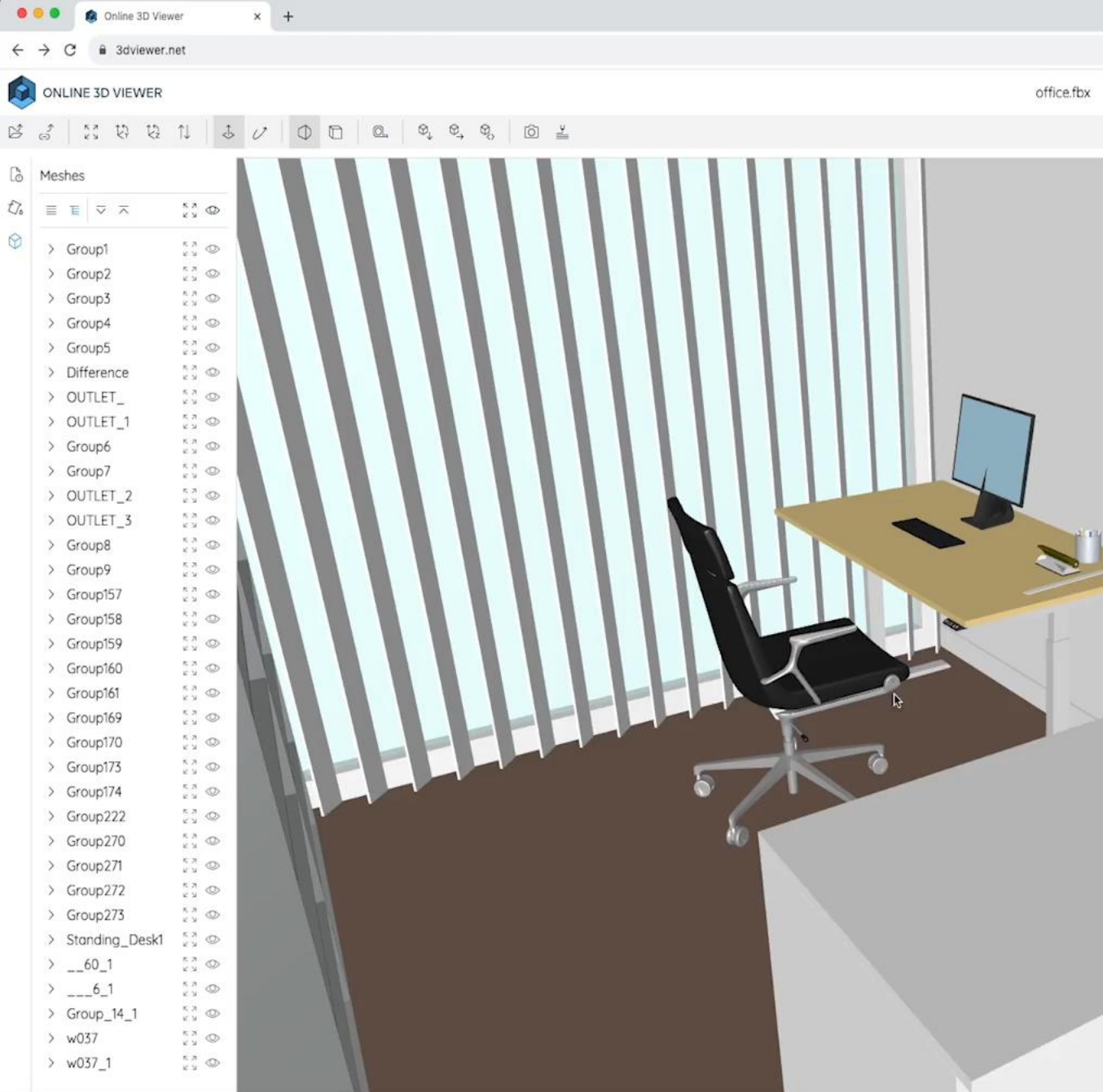


Write the Feedback

Example 3D Design Feedback:

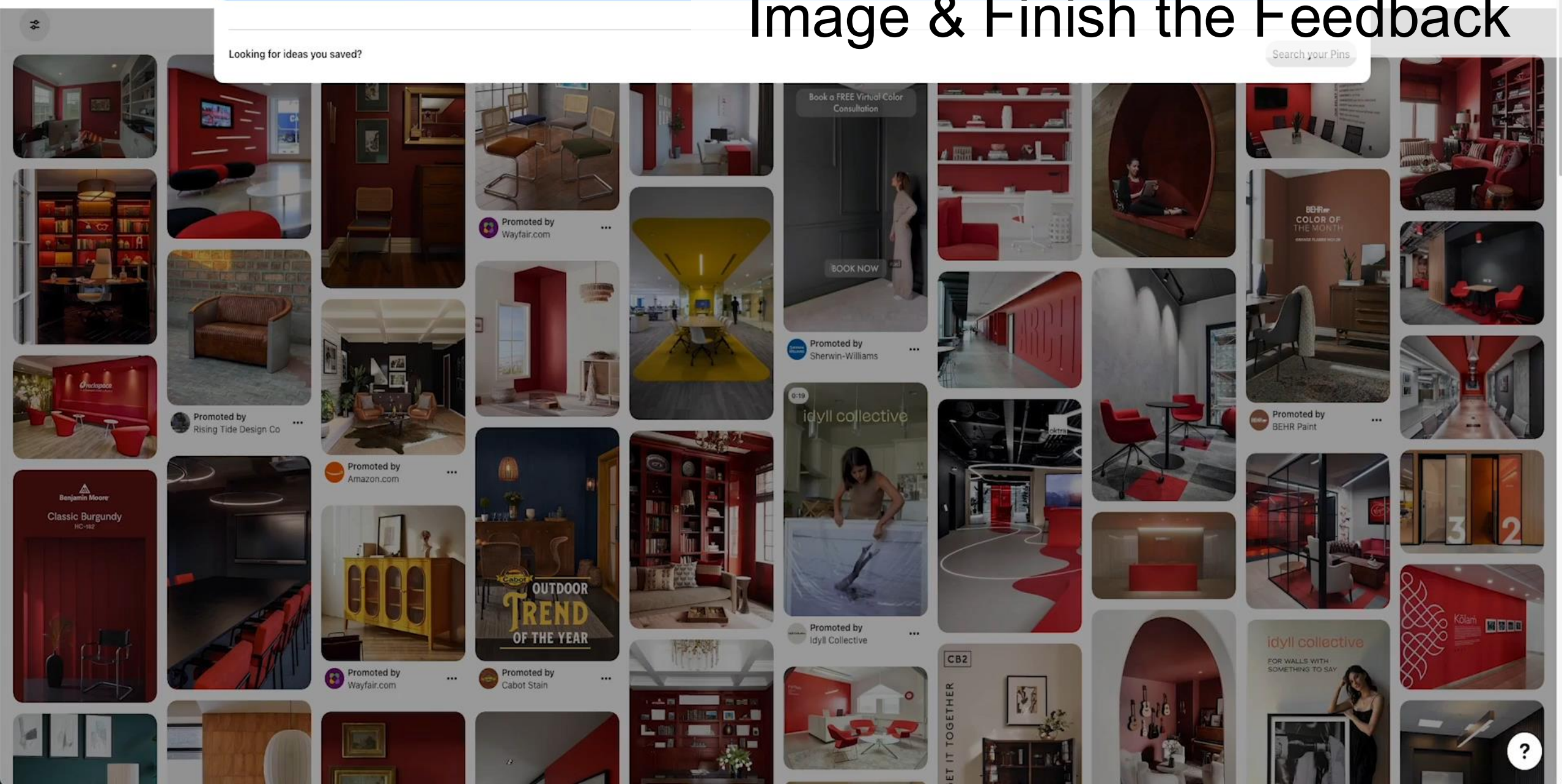
- Change to red wall paint.
- Use a curved computer display.





Find a Suitable Viewpoint

Search a Companion Reference Image & Finish the Feedback



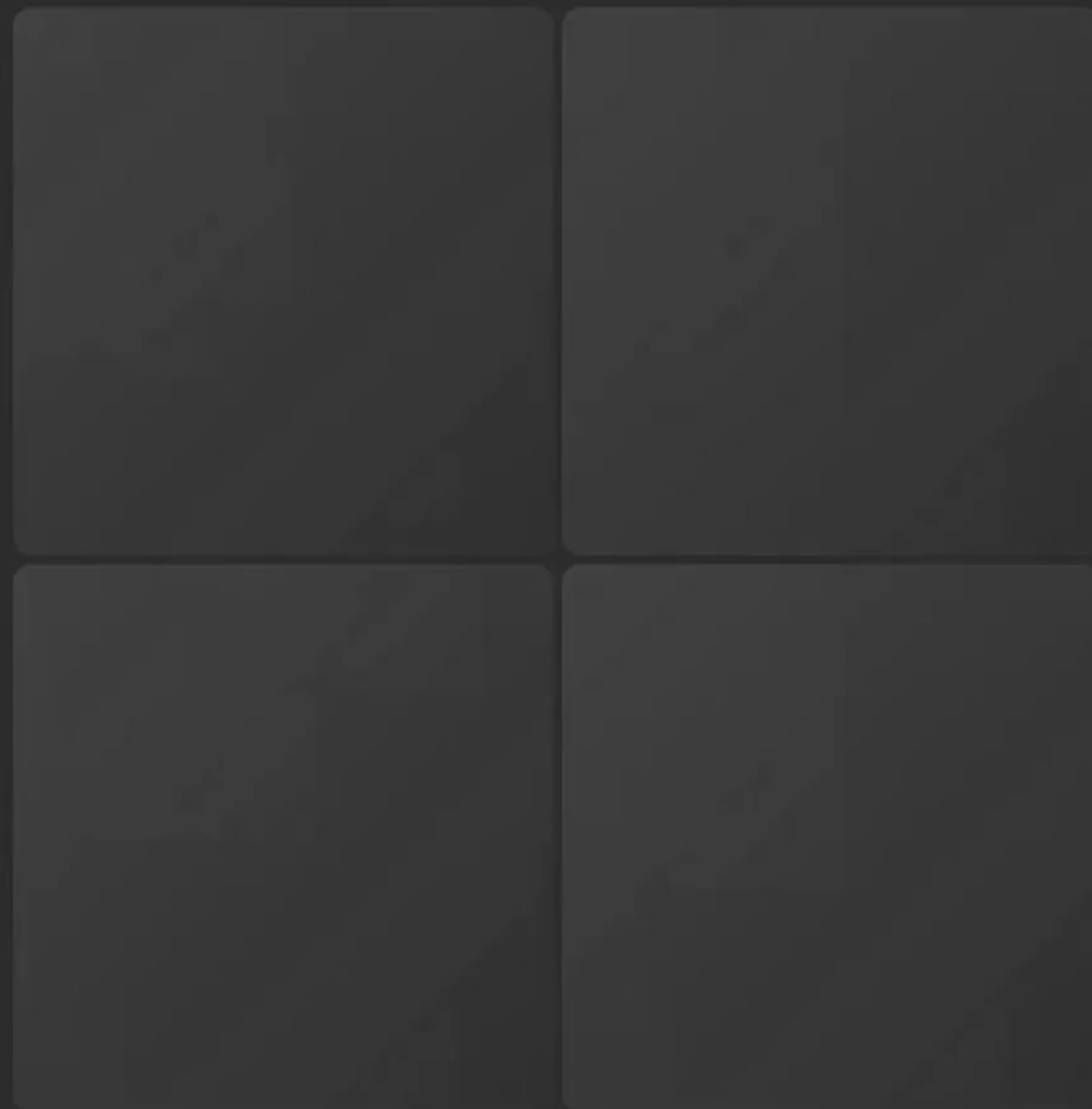
This Process is Not Easy!

- Time consuming and inefficient.
- Hard to find well-matched online images.
- Inaccurate reference images can cause misunderstanding.





Textual Prompt: *“an office with a red wall paint”*.



Prompt

An office with a red wall paint.

Example Powered by





Type Your Design Feedback:

Type your design feedback here. Hit "Shift" to explore the possible views...



MemoVis: A GenAI-Powered Tool for Creating Companion Reference Images for 3D Design Feedback

Load & Explore 3D Model



Type Your Design Feedback:

Type your design feedback here. Hit "Shift" to explore the possible views...

Typing Textual Feedback



ASSETS

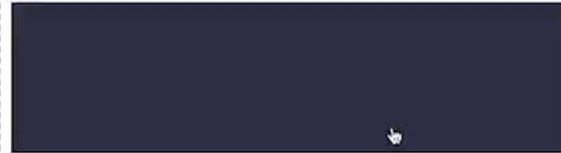
3D EXPLORER



Type Your Design Feedback:

Type your design feedback here. Hit "Shift" to explore the possible views...

Do you want one of following views?



Suggesting Views in Real-Time



Type Your Design Feedback:

I felt it might be a good idea to change the wall paint behind my yellow standing desk to red.



ASSETS

3D EXPLORER



Choose a Matched View



ASSETS

3D EXPLORER



Type Your Design Feedback:

I felt it might be a good idea to change the wall paint behind my yellow standing desk to red.

Do you want one of following views?

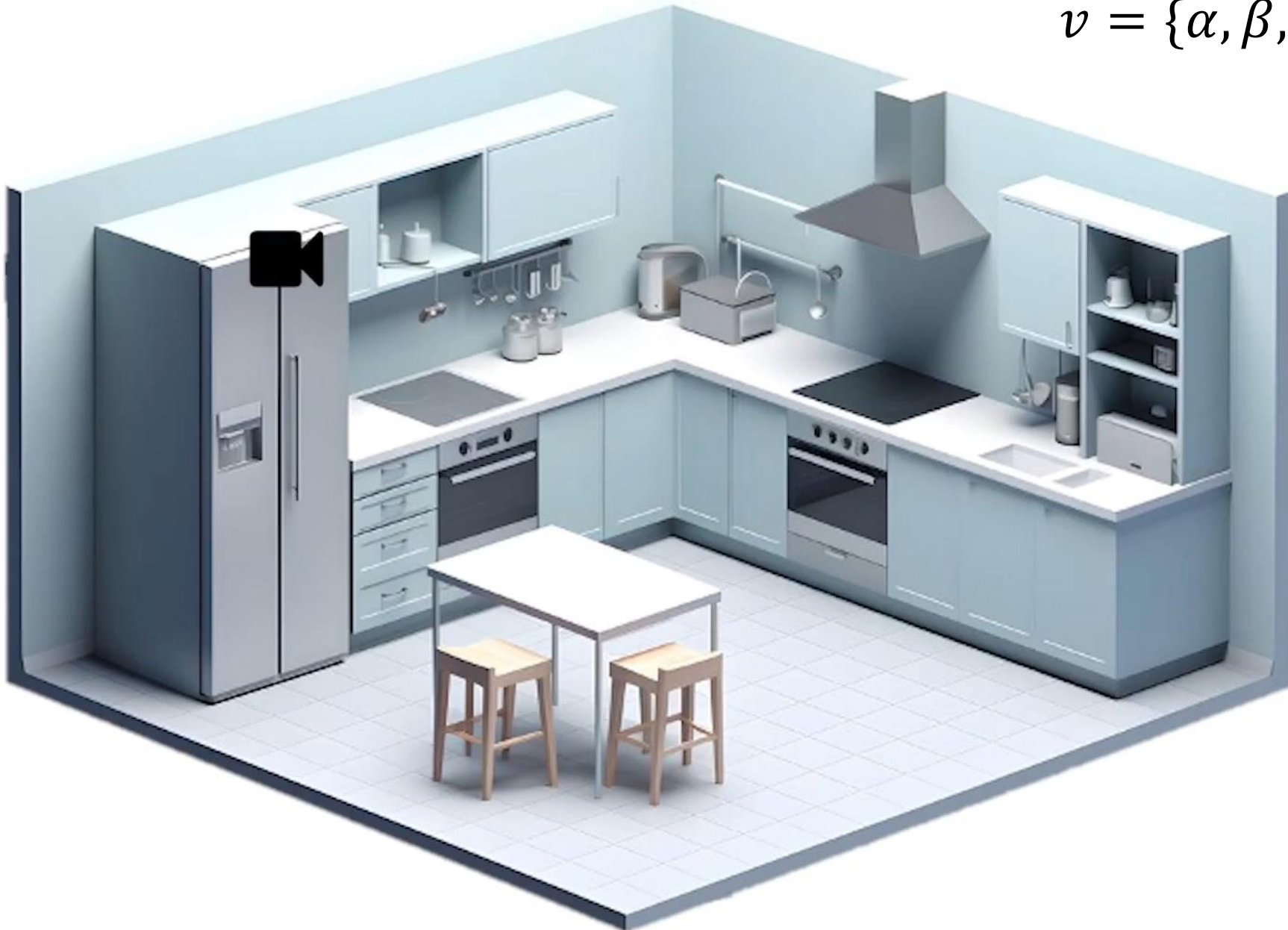


How do we realize the viewpoint suggestions in real-time?

View Sampling

Viewing Camera

$$v = \{\alpha, \beta, r, t_x, t_y, t_z\}$$



Viewpoint Suggestions in Real-time?

- When the 3D model is initially loaded

$$\mathbf{Encode} \mathbf{I}_v = f_{image}(\mathbf{I}_v), v = \{\alpha, \beta, r, t_x, t_y, t_z\}$$

- Upon finishing typing textual feedback

$$v = \operatorname{argtopk}_{v, k=4} \cos\{f_{text}(\mathbf{t}), \mathbf{Encode} \mathbf{I}_v\}$$



Textual comments typed by the feedback provider

Type Textual Prompt



Type Your Design Feedback:

I felt it might be a good idea to change the wall paint behind my yellow standing desk to red.

Crop the Relevant Region



ASSETS

GRAB'N GO



Type Your Design Feedback:

I felt it might be a good idea to change the wall paint behind my yellow standing desk to red.

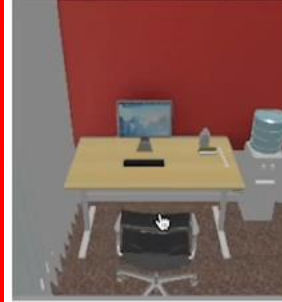


Finish Up Feedback

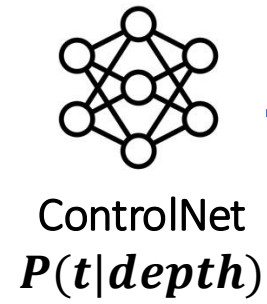


Type Your Design Feedback:

I felt it might be a good idea to change the wall paint behind my yellow standing desk to red.



ControlNet + SAM



 Segment
Anything Model



Change to a curved computer display?



Scribble & Define New Objects



Type Your Design Feedback:

I felt it might be a good idea to change the wall paint behind my yellow standing desk to red. This could help me enhancing my working productivity. We could also add a curved computer display on the standing desk. It could be good for my eye health.

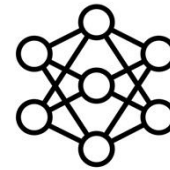
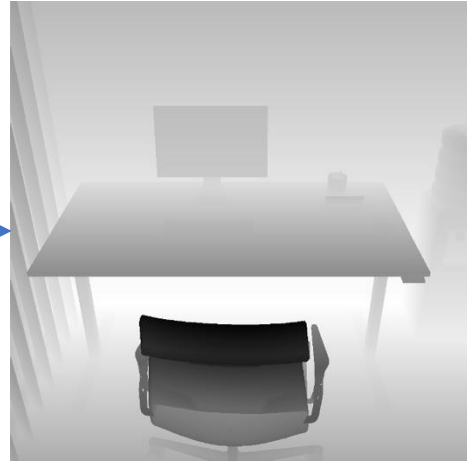


Text + Scribble Image Modifier

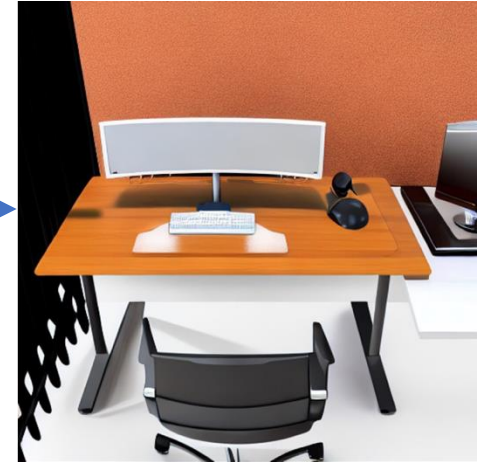
"An Office with a Curved Computer Display on the Desk."



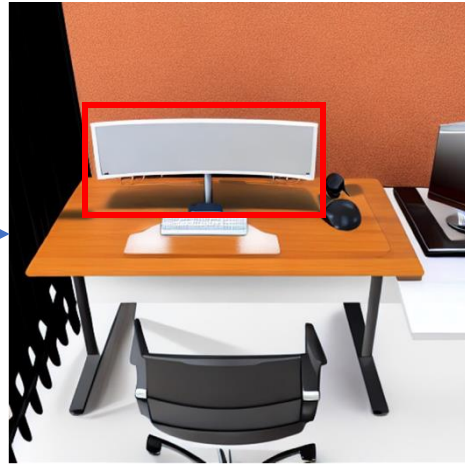
Initial 3D Design



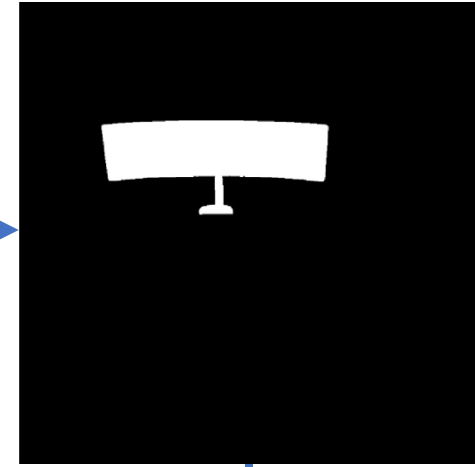
ControlNet
 $P(t|depth, scribble)$



Text + Scribble



 **Segment
Anything Model**



Initial 3D Design

Finish Up Feedback



Type Your Design Feedback:

I felt it might be a good idea to change the wall paint behind my yellow standing desk to red. This could help me enhancing my working productivity. We could also add a curved computer display on the standing desk. It could be good for my eye health.



Paint & Define New Objects



ASSETS

TEXT + PAINT



Type Your Design Feedback:

I felt it might be a good idea to change the wall paint behind my yellow standing desk to red. This could help me enhancing my working productivity. We could also add a curved computer display on the standing desk. It could be good for my eye health. We could also probably add a painting picture on the wall, behind the standing desk. This could help me relax myself during working break



mike@anonymous.designer

Subject

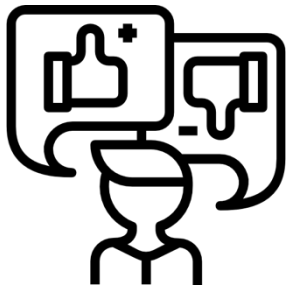
I felt it might be a good idea to change the wall paint behind my yellow standing desk to red. This could help me enhance my working productivity. We could also add a curved computer display on the standing desk. It could be good for my eye health. We could also probably add a painting picture on the wall, behind the standing desk. This could help me [relax myself during working break](#)



Send to the Designer

Deployment

Feedback Provider



Interact With

Model Service: Storing
and Serving 3D Models

RESTful
Request

AI Service

Gateway

Inference
Request Queue

- ControlNet
- Upsampler
- SAM
- Inpainting
- CLIP

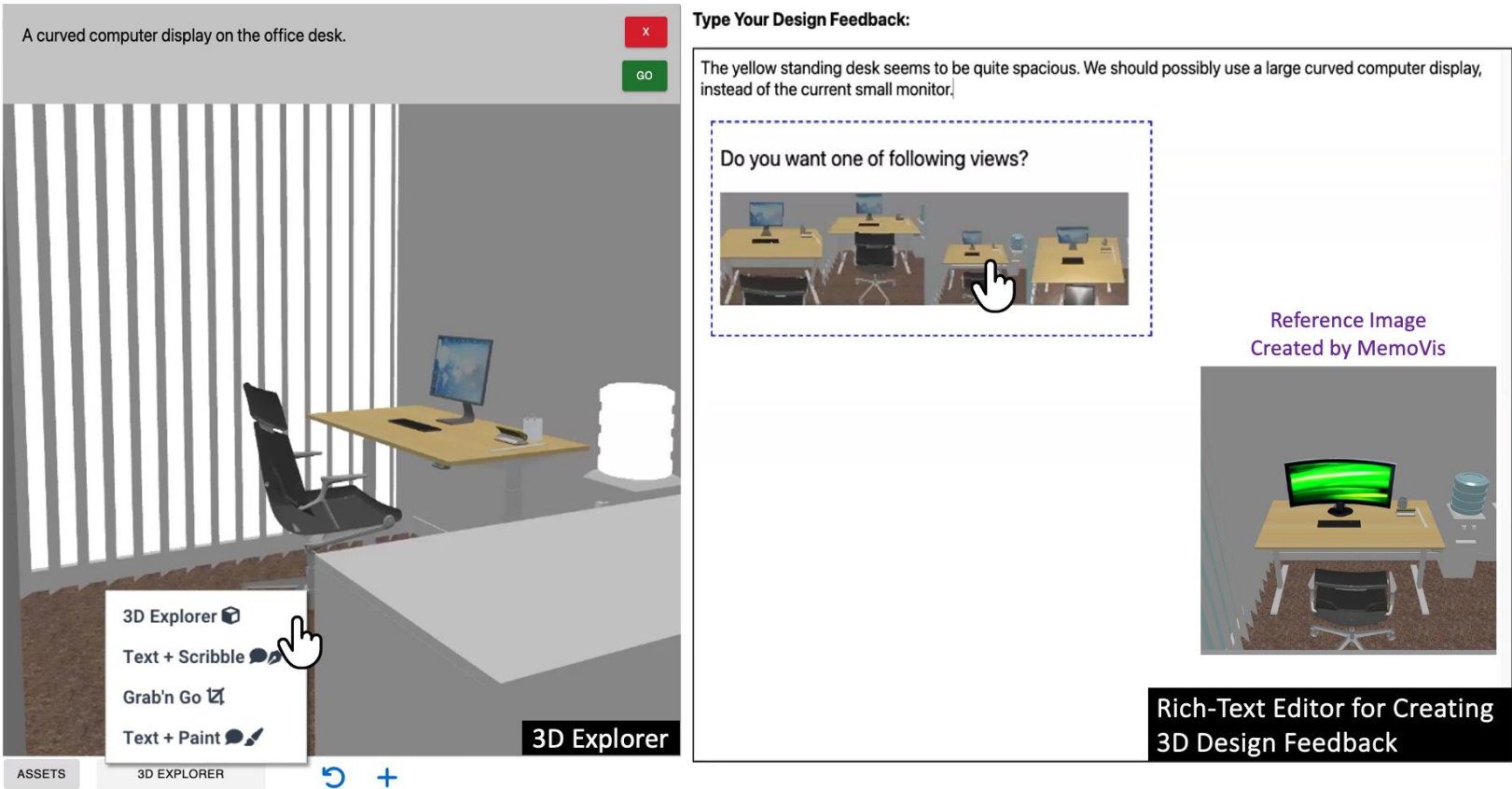


4 A10G GPU

Adobe Sensei

RESTful
Request

MemoVis: A Browser-Based App for Efficiently Creating 3D Design Feedback with Companion Reference Image



Two User Studies

Two User Studies

Study 1: Experience of creating 3D design feedback.

Study 2: Quality of the reference image.

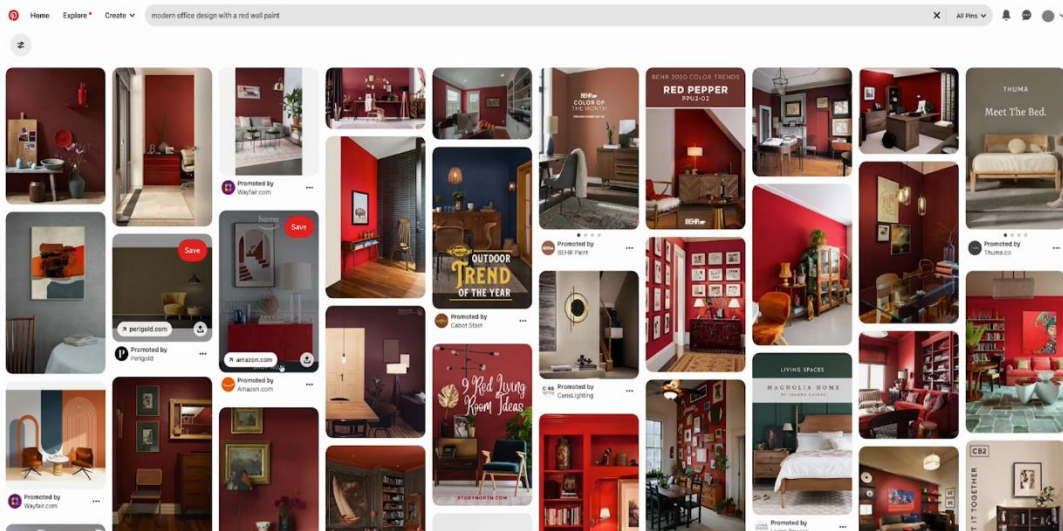
Study 1: Experience of Creating Reference Images

Participants: 14 Feedback Providers

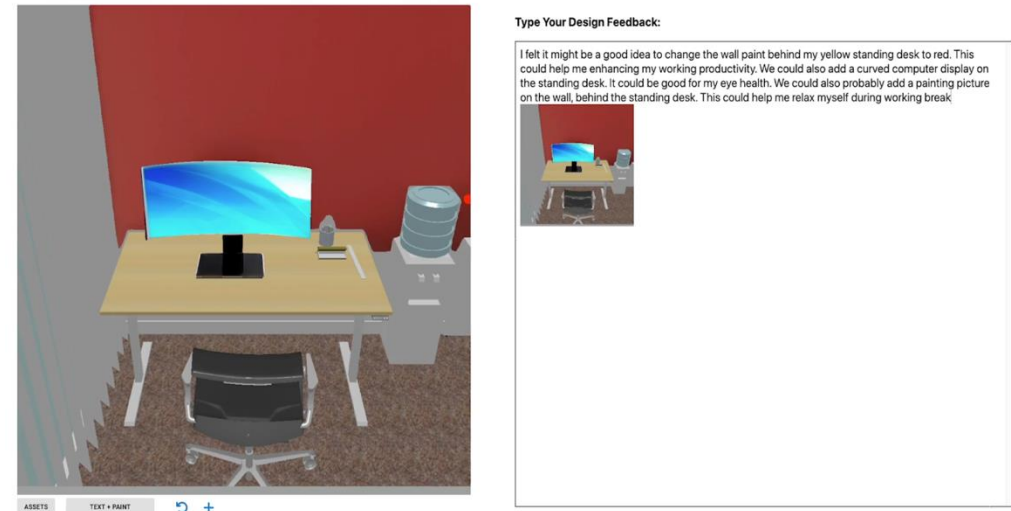
Research Questions (RQs):

- RQ1: Helpfulness of **real-time viewpoint suggestion** features can help feedback providers navigate the 3D scene while writing feedback?
- RQ2: How the **image modifiers** can help feedback providers visualize the textual comments for 3D design?

Interface Conditions:



Baseline: Reference image created by searching and/or hand drawing



MemoVis: Reference image created by MemoVis

Feedback Creation (Reference Image + Textual Comments)



Samurai Boy



Help Participants to Get Familiar with the System

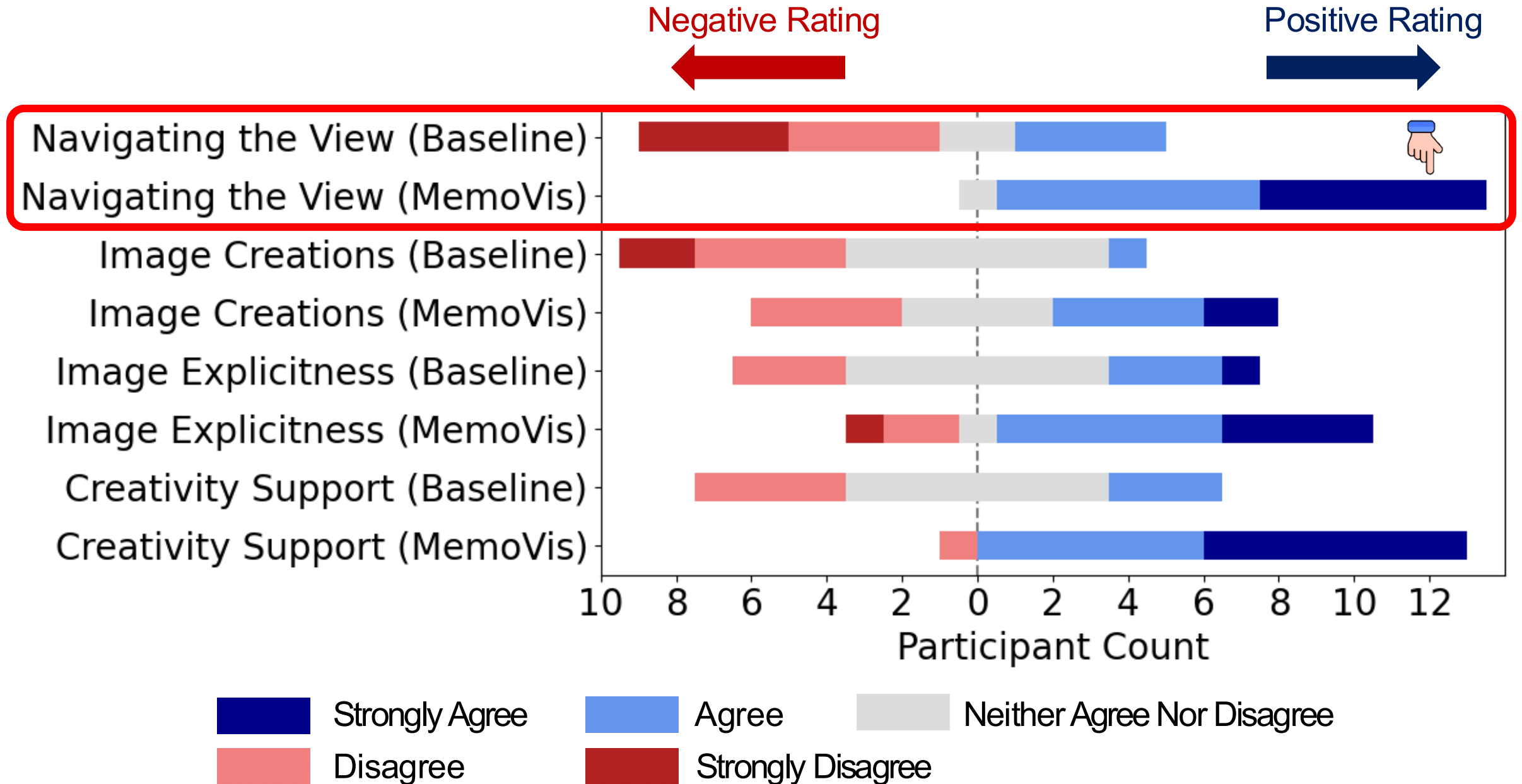


Bedroom

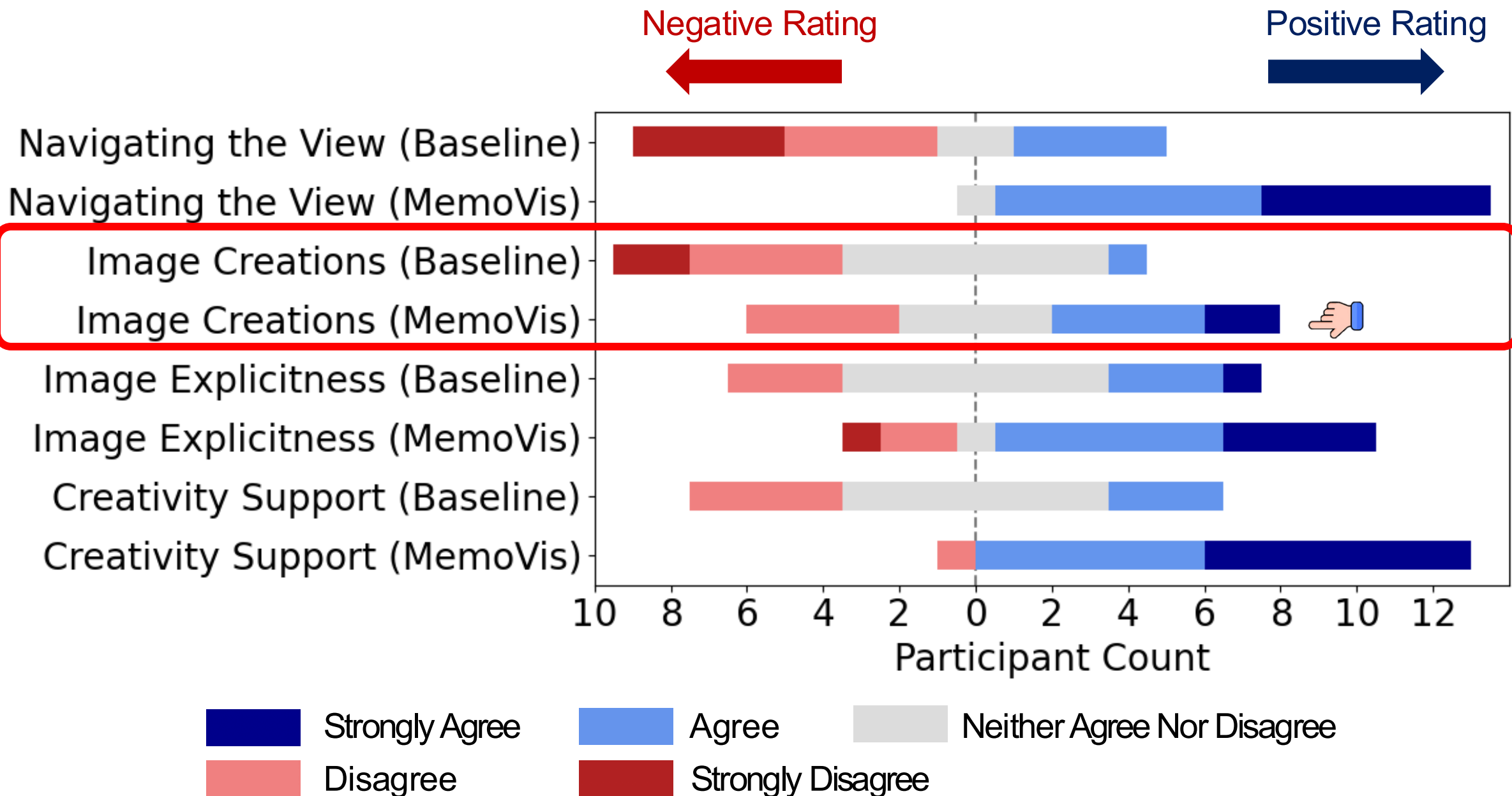


Car

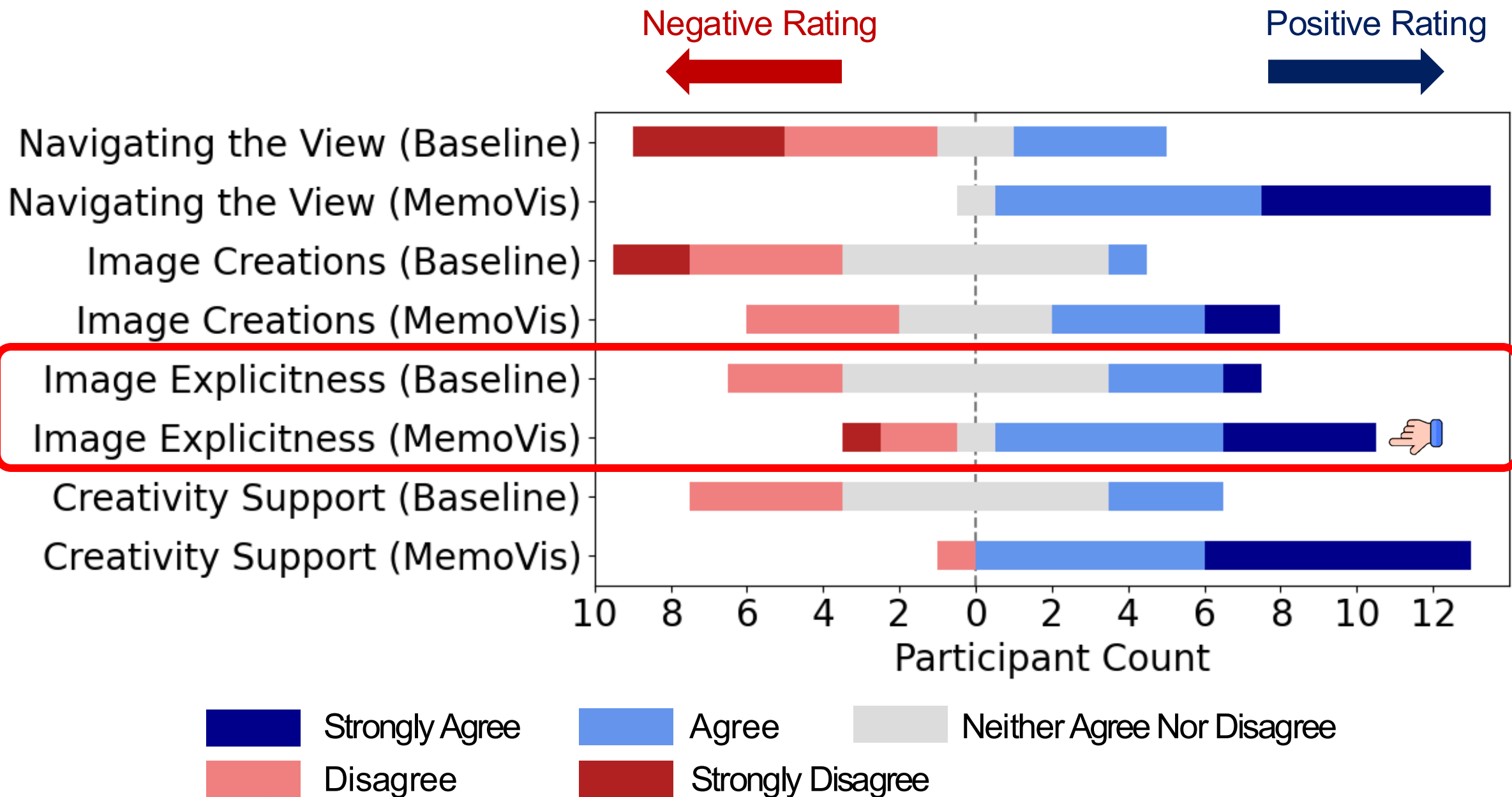
Study 1: Experience of Creating Reference Images



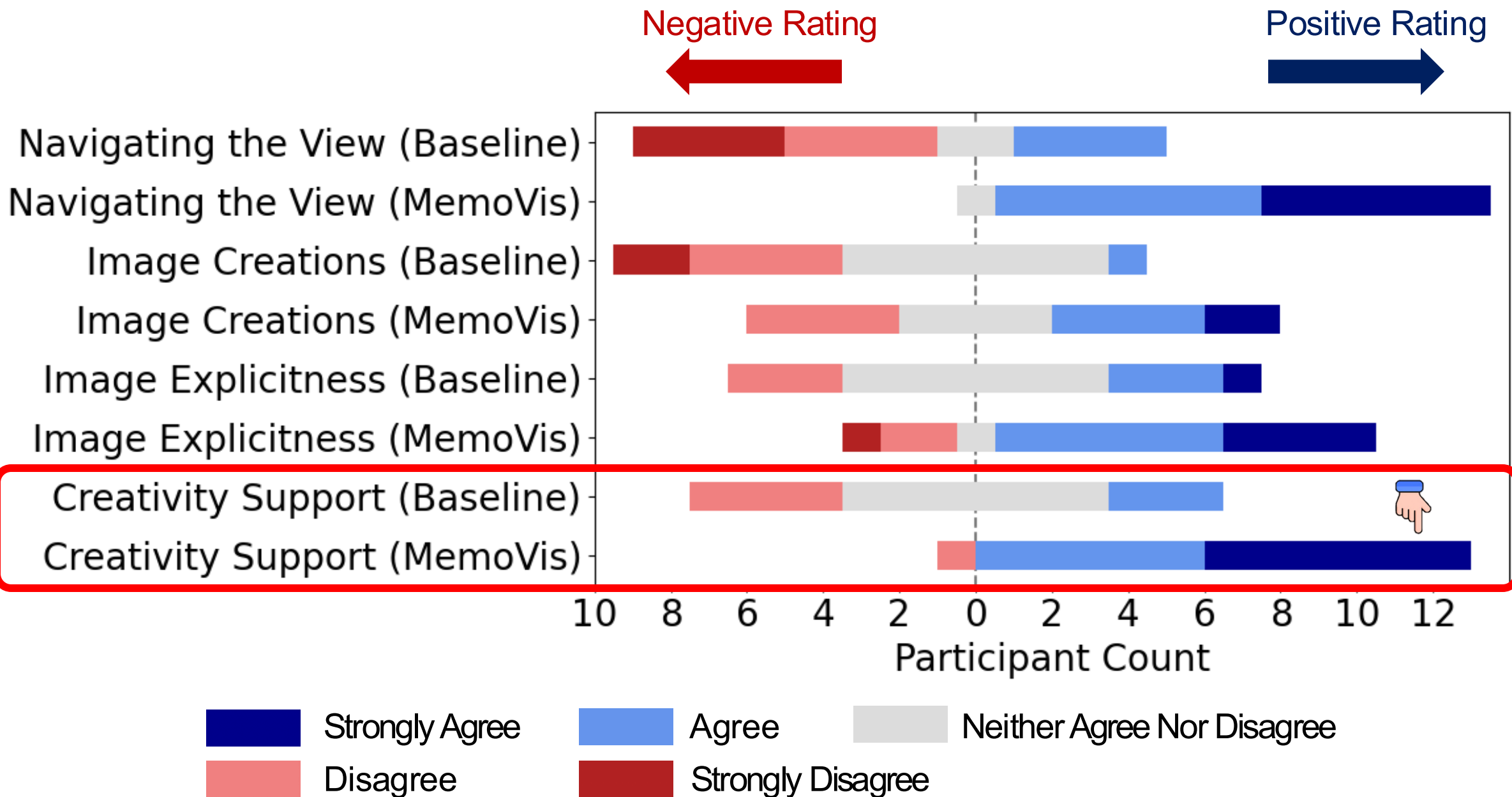
Study 1: Experience of Creating Reference Images



Study 1: Experience of Creating Reference Images

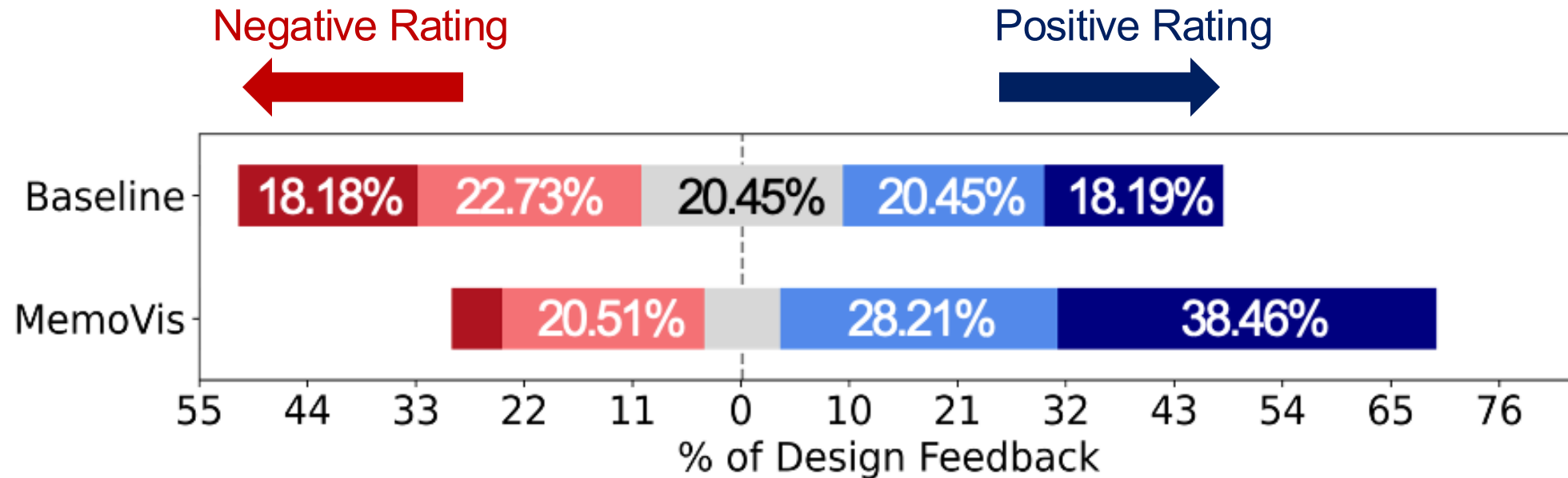


Study 1: Experience of Creating Reference Images



Study 2: Reference Image Assessment (N = 8)

How well the reference image could convey the gist of textual comments?

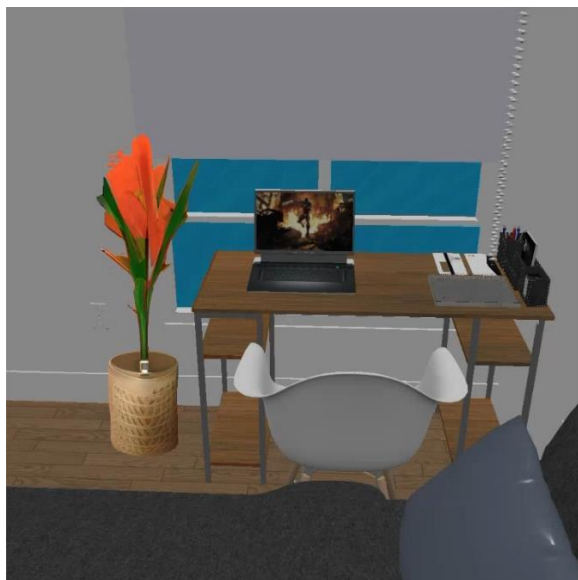


3D Design Feedback Examples with MemoVis

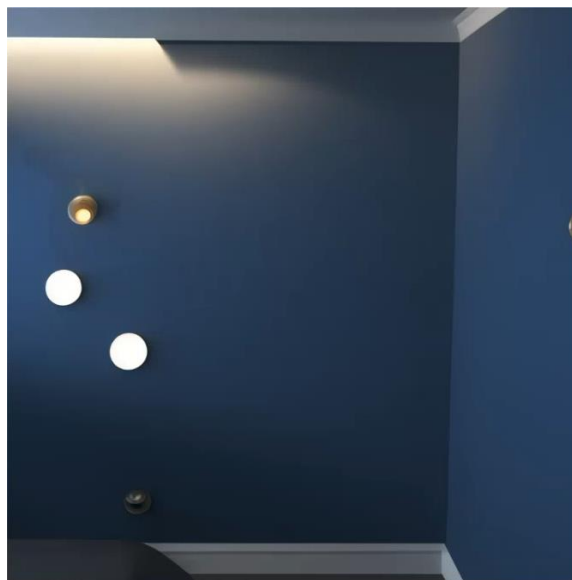
Anchored View of
the Initial Design

Reference Images

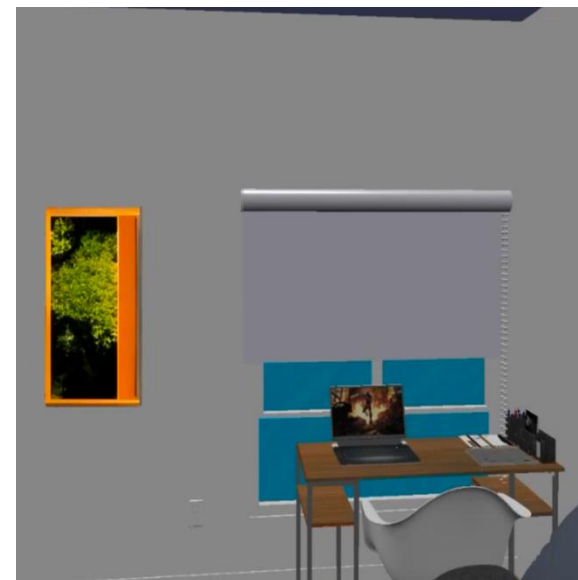
Add an Indoor Plant



Modify the wall design



Add a wall poster

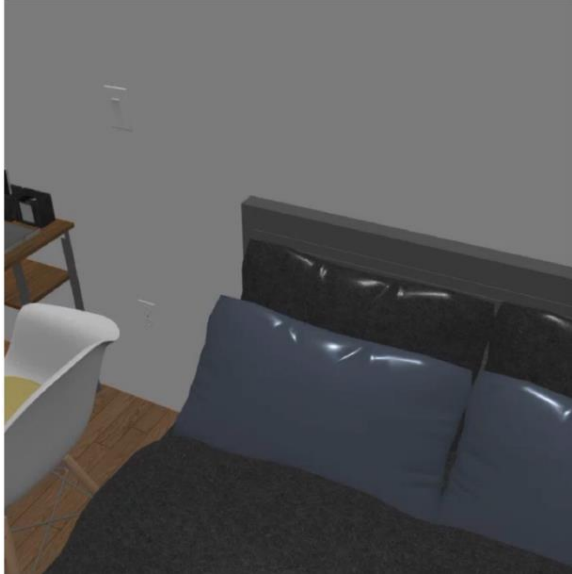


3D Design Feedback Examples without MemoVis

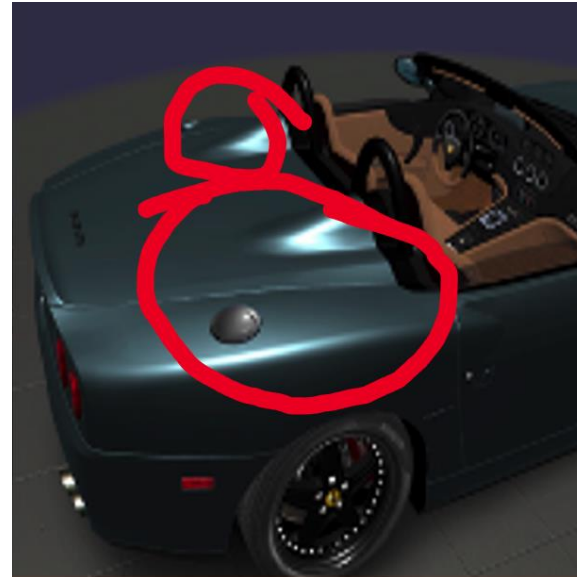
Anchored View of
the Initial Design

Reference Images

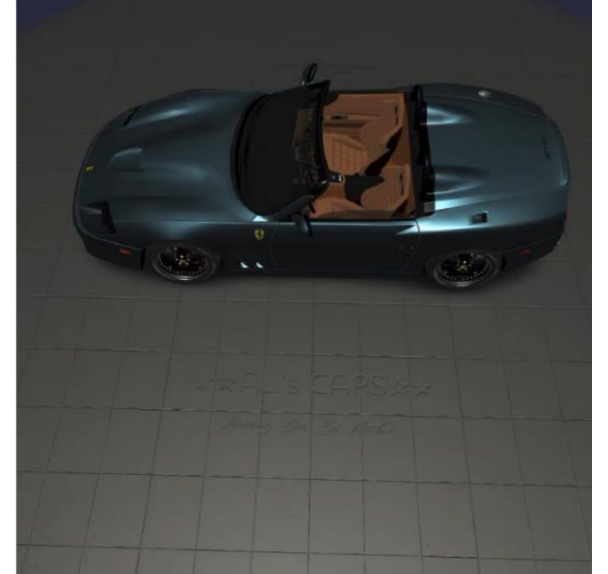
Change to suspended bed



*Change the color to be
more metallic*



Add a pet seat



For More Details, Please Refer to Our Paper!

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Manuscript



Video

