Generative Image AI Using Design Sketches as input: Opportunities and Challenges

Chengzhi Zhang
chengzhz@andrew.cmu.edu
School of Architecture, Carnegie Mellon University
Pittsburgh, Pennsylvania, USA

Weijie Wang
weijiew@andrew.cmu.edu
School of Design, Carnegie Mellon University
Pittsburgh, Pennsylvania, USA

Paul Pangaro
ppangaro@andrew.cmu.edu
School of Architecture, Carnegie Mellon University
Pittsburgh, Pennsylvania, USA

Nikolas Martelaro
nikmart@cmu.edu
Human-Computer Interaction Institute, Carnegie Mellon University
Pittsburgh, Pennsylvania, USA

Daragh Byrne
daraghb@andrew.cmu.edu
School of Architecture, Carnegie Mellon University
Pittsburgh, Pennsylvania, USA

ABSTRACT

Generative image AI has sparked heated discussion among creative professionals. However, how it might be a tool for design practice is understudied, and it is not yet understood how designers may find image AI helpful across the stages of design practice. To address this, our preliminary study explores how designers use generative image AI accompanied by design sketches to inform early-stage 3D design. Further, we also examine the perceived limitations of text-to-image models. To do this, we recruited 11 Architecture graduate students with a median work experience of 2 years. Participants completed a design task using generative image AI packages and incorporated design sketches as inputs. The study findings provide insights into how image AI can or can not be a valuable resource for architectural design practitioners. Further, findings suggest possible directions for future image AI-assisted design tools and workflows.

CCS CONCEPTS

• **Human-centered computing → Empirical studies in HCI**; • **Applied computing → Computer-aided design**.

KEYWORDS

generative model, image AI, design sketch, architectural design, qualitative study

ACM Reference Format:
Chengzhi Zhang, Weijie Wang, Paul Pangaro, Nikolas Martelaro, and Daragh Byrne. 2023. Generative Image AI Using Design Sketches as input: Opportunities and Challenges. In *Creativity and Cognition (C&C '23), June 19–21, 2023, Virtual Event, USA.* ACM, New York, NY, USA, 8 pages. https://doi.org/10.1145/3591196.3596820

Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored. For all other uses, contact the owner/author(s).
C&C '23, June 19–21, 2023, Virtual Event, USA
© 2023 Copyright held by the owner/author(s).
ACM ISBN 979-8-4007-0180-1/23/06.
https://doi.org/10.1145/3591196.3596820

1 INTRODUCTION

The high-performance outcome of diffusion models (like Dall·E 2, Midjourney, and Stable Diffusion) has sparked heated discussions about the negative social issues of generative image AI (also known as "AI image generation models" or "AI image generators") [4, 10]. But how can image AI can be a resource for design practice and where does it belong in design tooling? Sometimes image AI's outcome may not suit the real-world purpose (like the manufacturing feasibility, user's common expectation, etc.), which could result in designers perceiving image AI as a less helpful design tool. Recent research has used image AI to inform 3D sculpture building [11] and to reflect on how it can mediate, shape, and 'make strange' creative processes [14]. Much of this work focuses on computational methods and platforms that enable generative image AI to be more reliably used as a productive design tool. For example, ControlNet [15] significantly reduces the non-deterministic outcome of generative models by allowing designers to provide a sketched outline as an input to image generatation. Qiao, Liu, and Chilton similarly note that image input can improve subject representation when using image AI for generating art [9].

With AI tools becoming more available to designers, we were interested in examining how design sketching within an image AI generation workflow can be valuable to designers. More generally, we sought to uncover how image AI might augment design practice. To do this, we conducted experiments with 11 architecture students, assigning them to the same design task and using design sketches as the input for image AI. Our preliminary findings show that image AI accompanied by design sketches is valuable for informing early-stage architectural design as it helps generate more design directions. The findings also shed light on the challenges of incorporating image AI for design purposes and future image AI-based design tooling directions.

2 RESEARCH BACKGROUND

Generative AI as a source of creativity support has gained popularity in recent years[8]. Emerging research has demonstrated the potential of generative AI models in providing creative writing suggestions [5] as well as in generating advertisement posters [3], illustrative images for news [7], and graphical user interfaces[16].

Generative image AI has simultaneously garnered much public interest, as the fidelity and versatility of the diffusion model's outcomes, as compared with VAE and GAN, are unparalleled. To better utilize image AI, researchers are developing guidelines for prompt engineering [6], proposing textual inversion techniques [1], and forming design guidelines for image AI applications [13].

The high-fidelity outcomes of image AI illustrate many potential applications in 2D design tasks. However, generative 3D design approaches are still in development. Two major barriers to high-performance generative 3D design are a lack of a large 3D dataset and the computation power required to achieve a satisfactory and deterministic result. GET3D [2] model's performance on generative 3D textured meshes is impressive. However, it's still far from the quality needed for applications in product design and architecture domains. Such applications would require the high-accuracy non-uniform rational B-spline (NURBS) widely used in 3D modeling to guide the following manufacturing and building purposes. There are, however, intermediary approaches that can be explored. For example, recent work has explored the possibility of utilizing generative 2D image AI to inform 3D sculpture-building practice [12], which is the approach we take for our study.

3 STUDY DESIGN

We recruited 11 participants with a background in architecture for the study. Each session lasted around 75 minutes, consisting of 10 minutes of an introduction, 45 minutes of design work, and 20 minutes for a debrief interview. Before the study, all participants signed a consent form approved by our institution's IRB. Participants were compensated with a USD $15 gift card. We recruited participants using word of mouth, posters around campus, and an advertisement via an email list. Our inclusion criteria were: the participant must be proficient in English while having at least three years of Architecture-related study or work experience.

Each study session consists of three sections:

Introduction Section: The 10-minute introduction section familiarized participants with the study and the AI tool. We first reviewed an introduction document (which includes the instructions for using DreamStudio) with the participant. After which, the participant used the Procreate [1] package — a software tool for digital painting - running on an iPad to sketch a mug, upload it to the AI platform — the DreamStudio [2] image AI website —, generate variations, and then download an image output back to the iPad to overlays additional sketches upon. This was intended to highlight the opportunities for iterative sketching with generative AI tools.

Design Section: Once introduced to the generative AI workflow, we assigned each participant the same design prompt:

You are an Architect, and your client is a famous hotel brand. They need to build a new hotel near the sea. Think about your favorite architectural styles and design this hotel.

The participant used the design section to prepare a design with the sketch-AI generation workflow described in the Introductory section. The participant was asked to use this iterative process until either they were satisfied with the design or reached the time limit of 45 minutes. We observed their interactions (see Figure 1) and captured input prompts, input sketches, and generative image outputs during this section.

Interview Section: After that, we proceeded to a 20-minute semi-structured interview section. The four open-ended questions that guided discussion are provided (see Appendix subsection A.2). This debrief interview probed their experience with the design process, challenges encountered, opportunities to improve AI interactions within the AI sketching workflow, their willingness to incorporate image AI into their real workflow, and the relationship of image-AI to their current practice. The interview was audio recorded, transcribed, and coded using affinity diagramming.

During the session, we provided guidance to participants when they asked for help or got stuck in the design process. Guidance included suggesting variations to their prompts and/or ways they could adjust the parameters. It is important to note that P1, P2, and P3 had difficulty using DreamStudio to prepare variations of their iPad sketches. These participants did not receive enough variations because of DreamStudio not functioning correctly, because of the prompt used, or because of the input parameters. To address this, we highlighted relevant instructions provided in the introduction session and contained supporting document as needed.

Appendix subsection A.1 offers a table containing the participants' final designs, their time on task, and the prompt used to prepare this outcome.

4 STUDY FINDINGS

We next present findings based on insights from the interview data and from the observational data collected during the design task.

Figure 1: Design evolution throughout a session. P6 (left) navigates possible variations and refines the design (right).

4.1 RQ1: What Works Well for Designers

4.1.1 AI helps generate inspiration and develop concepts. Most participants found the AI workflow offered a potentially useful source for finding design inspiration within early-stage design processes. P5 remarked that they thought that *"it generally works pretty good for the, for the sketches, because the sketches are still like very, I would say, a very open part of it... you can see the* ***ideas keep evolving****."*. Almost all participants also appreciated that using image AI could also

[1]Procreate: https://procreate.com
[2]DreamStudio: https://beta.dreamstudio.ai/dream

Table 1: Participants demographic information

ID	Gender	Age Years	Degree Level	Domain	Design Sketch Frequency	Study Exp. Years	Work Exp. Years
P01	F	24	Masters	Computational Design	On a monthly basis	6	2
P02	F	NA	Masters	Architecture	Several times a month	7	5
P03	F	25	Masters	Architecture	On a monthly basis	6	2
P04	M	28	Masters	Advanced Architectural Design	On a daily basis	6	5
P05	M	25	Masters	Computational Design	Several times a week	6	3
P06	M	24	Masters	Computational Design	Several times a month	6	0
P07	M	26	Masters	Computational Design	Several times a month	5	1.5
P08	M	32	Masters	Computational Design	Several times a week	6.5	9
P09	M	33	PhD	Computational Design	On a daily basis	11	3
P10	F	34	Masters	Computational Design	I seldom sketch	6	8
P11	F	24	Masters	Urban design	Several times a week	7	1

quickly produce a lot of variations of early-stage work, allowing them to quickly expand the design space and design possibilities. For example, P6 noted: *"I think it works really well in **providing you with some different possibilities**. So it's, I think it's a really **great brainstorming and... concept development tool**."*

4.1.2 Designers think AI enhances design sketching . Many participants (P3, P5, P8) favor AI's ability to transition designs from low-fidelity to high-fidelity outcomes by converting their drawing into a more realistic picture. P3 described how *"If you give a basic render, and then you just type in some commands, it **improves the quality of the image** a lot more, which I've seen quite a bit of people doing (P3)."*. P5 mentioned that AI tools help to create a uniform style across images. During the design session, P5 sketched some rough overlay on the image to represent the helicopter in the sky and the boat in the sea. After sending the rough sketch back to DreamStudio, they get an image with the hotel, the helicopter, and the boat in it, all in a similarly rendered style (see Figure 2). Conventional approaches to doing this within traditional practice could take considerably longer. P5 explained to add one extra element (like the helicopter) to the existing picture would have needed them to search the internet, find a reference image with similar perspectives and styles, and then use software like Photoshop to add the element manually. The image AI helps blend and integrate elements into the scene. In this way, it could also reduce time-intensive tasks in design conceptualization. P8 remarked that *"this is actually something that **enhances the sketch**. So I was surprised...I think that's a **desirable sketch quality** that I never really even asked for."*

4.2 RQ2: What Challenges Do Designers Encounter

4.2.1 Designers found understanding how to adjust the parameters to meet their goals confusing. The first three participants encountered the same challenge: the AI did not create outputs with enough variation based on the sketch input. P2 discussed how the AI *"was just giving the same drawing back to me. So maybe it's the way I do it? I'm **not sure** why that didn't work quite well."* We observed that it was often unclear to the participant if this lack of variation was a result of their misconfiguration of the generative input (e.g. not setting the parameters correctly) or if it problem lay with the AI itself. For example, P1 explained *"when I adjust the steps it takes before it generates... before it outputs, they're **still identical**. So I was quite confused as to why this happened."*

4.2.2 AI does not understand design domain knowledge. Three participants (P4, P6, P9) mentioned wanting the AI to better interpret domain-specific terms for architecture. P6 specified in the prompt that they needed that building to be *"with tectonics facade."* This term would be known and understood by an architectural designer, but the participant did not get the expected outcome with AI as the tectonics structure was not on the facade, but placed elsewhere on the form. P6 instead used Procreate to draw an overlay that helped overcome this AI interpretation challenge. P4 expanded on this issue discussing that *"[a] designer will know what that means in terms of form that has like a **bio-metric** or bio-mimicry term to it, but **the computer does not know** what, what does that mean in terms of geometry."*

4.2.3 AI generates surreal images that are not suitable for architectural purposes. It was common that the AI would result in images that were unrealistic or impossible to construct. P1 and P5 explicitly mentioned that they are getting images that are not feasible in real-world contexts. For example, P1 received a building with roof tiles on the floor: *"... when I was looking at those images, I said, Oh, this is **really not realistic**. Because there's something that looks like a roof structure or a roofing material that's actually laying on the ground."* . While P5 received images of the building on the sea noting that *"some of the images like this one might **not make sense** at all."* The same circumstances, namely generative images unsuitable for common architectural construction, were observed in other design sessions and were equally seen to slow down and hindered the design process.

4.2.4 The trade-off between designer's flexibility of design intent and perceived utility of generated outcomes. There is a trade-off between the designer's flexibility and the perceived usefulness of AI. P5 and P6 input rough designs as line-based sketches, and they expressed more satisfaction with what the model generated and appeared to

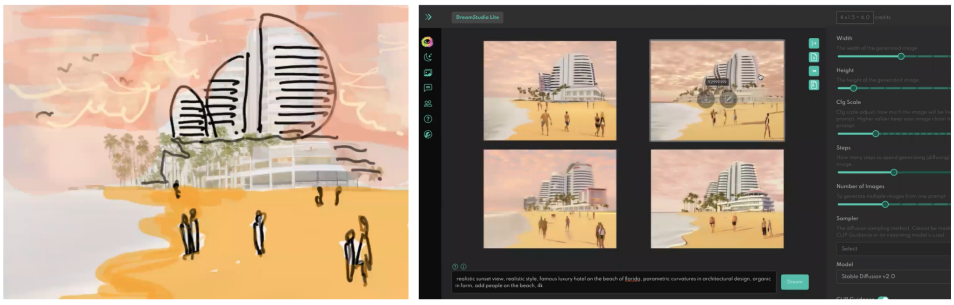


Figure 2: Left: P4's design sketch input. Right: AI-generated design variations

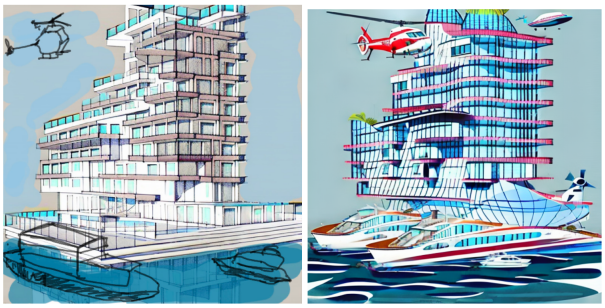


Figure 3: Left: The original input P5 uploaded to the platform. Right: AI's output of one uniform style

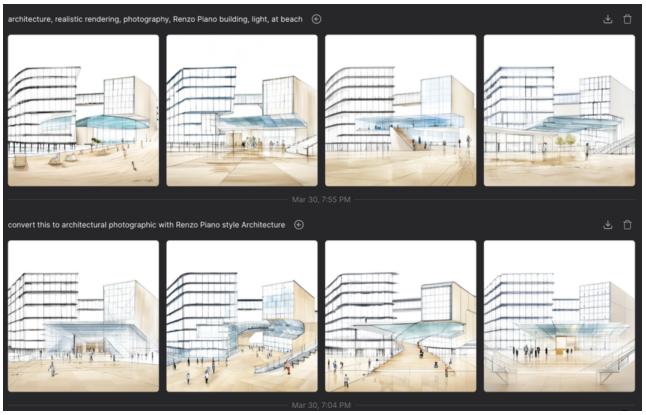


Figure 4: Screenshot of images generated by P9

be open to the possible design directions the AI suggested. However, P9, who had upfront defined a more clear image of the final design output, wanted to use AI to turn the design sketch into a higher fidelity architectural rendering. P9 was ultimately not satisfied with the outcome as AI did not translate the sketch into the specific style ("Renzo Piano style") they desired (see Figure 4). *"Because I have **a photograph** in my brain (P9),"* they found there to be a large gap between images generated by AI and their desired image. In contrast, those participants who were more exploratory found the AI helped in *"producing a really quick, messy idea, again, just to convey, like, the**very loose intent** and emotion of a potential project. I think it did that well (P8)."*

4.2.5 Designers lack prompting skills to coordinate with generative image AI.. We observed that our participants had a hard time coordinating with AI initially. The participants tried to "converse" with or issue a design instruction to the AI instead of using a set of descriptive words that the Diffusion Model could use to process into an image. For instance, P6 began by entering "I want to make the mug have an illustration of a yellow cat on it" and P6 failed to get the output image that aligned with their command but recognized the mismatch: *"the challenge I have is, I know that the AI model is **not really thinking the way** that we comprehend things (P6)."* Although, we provided a prompt guide in the introduction document, many designers were still inclined to use conversational or instructive communication.

4.3 RQ3: Directions for Improvement in Image AI Tools

4.3.1 An integrated platform for direct drawing and rendering. Participants generally saw a generative image AI platform that integrated the sketching workflow would be useful. Participants mentioned they don't want to go back and transfer from the iPad to the computer to process the image. P4 said *"I don't want to come back to the drawing pad to do the file transfer processes. And entering the prompt is so easy."* while P8 remarked *"...if there was more of an **integrated approach** to like drawing, actually just drawing on the interface..."*

4.3.2 Designers seek more fine-grained control of the image-AI.. Although image input does help to reduce the uncertainty of image AI's outputs, many participants still expressed a desire for more detailed control: *"Maybe it needs **more detailed controls** for designers."* P5 suggested a feature of Midjourney — the ability to set the weight of each word in the prompt — as desirable and useful to offer more control. P8 expressed that they were *"looking forward to a little bit **more control** over like partial generation"*; partial generation exists in Dall·E 2 as an in-painting and out-painting feature. P9, who has a background in both Machine Learning and Architecture, pointed out that model fine-tuning would be advantageous: *"I can fine-tune this Stable Diffusion model. And then I can convert a data*

*image into that tone, you know, we need to **fine-tune** it if you want to use a specific domain."* P9 also wished for the ability to save their model presets for future architectural design explorations.

4.3.3 Enhancing interpretation of domain-specific design terms. Three participants (P4, P6, P9) mentioned that they wanted to have a domain-specific AI that could better interpret architecture terms. P4 mentioned that it would be great if they could choose different architectural styles and generate images with those known styles applied: *"For example, you have a **library of each style** and a certain style of architecture, labeled by their names of architects (P4)."* P6 similarly noted *"... Richard Rogers or Renzo Piano, those are the people who are very interested in exposing the structure, exposing tectonics. And I don't think all the tool has the ability to identify what was like, I mean, by tectonics, what's the structure of those things, but, but if like, they're able to detect those, I think it's gonna make it very interesting (P6)."*

4.4 RQ4: Willingness to Incorporate Image AI Tools

4.4.1 Most participants are willing to incorporate the AI tools into design. Most participants expressed their willingness to incorporate AI tools into their future design workflows. The first three participants were not positive due to the obstacles they encountered; the AI failed to give them enough useful design variations. For participants who did not have image variation issues (P4-11), nearly all expressed a willingness to use AI in the future workflow: *"I certainly think it would **enhance the design process** (P8)"*.

4.4.2 Where generative image AI belongs in design tooling. Participants acknowledged AI's role in helping early-stage design exploration and brainstorming (P6, P10): *"it definitely will encourage me to be **more creative** about the exterior design (P6)"*. P8 clarified that they believe that *"it's not so much enhancing the sketching process so much as it's enhancing the **inspiration process** (P8)."* However, participants also thought it would be hard for AI tools to work in the latter design phase when they have a clearer design idea specified and might only need to finalize design decisions (P4, P5, P10): *"it's not critically helpful in terms of helping you **finalize the design** (P4)"*. Some participants, especially participants with many years of work experience in architecture, indicated they would not directly share generative AI images with clients: *"It's still **at a distance** from like a real go, go to your client and talk to them. (P5)"*. Firstly, they think what AI generates is not the final design (P4). Secondly, our participants believe it may have an impact on perceived professionalism, and they did not want their clients to know that the images are generated by AI (D11).

5 LIMITATIONS

It is important to acknowledge that all participants in our study are design students and have limited exposure to and experience in professional practice. As such, findings may not generalize to workplace settings. Additionally, seven participants are in the domain of computational design. As such, they may be more inclined to adopt and explore new technologies for creative practice. Finally, the study time was relatively short (45 minutes) and in practice, similar tasks take place over extended time frames. This also means that some participants, particularly those without prior exposure to generative image AI tools, may not have had enough time to develop competency using image AI tools during the session. Consequently, additional and broader term studies are needed to better understand designers' needs, values, and perceptions of generative image AI.

6 CONCLUSIONS

This study explores how designers would use generative image AI with design sketches as the input. After experimenting with this mixed-modality input way of working with image AI, most designer participants expressed their willingness to incorporate generative image AI into their current design practice, especially in the early stages of design. Specifically, designers value using image AI as it helps generate design alternatives and brainstorm new design directions. Besides, they value image AI's role in enhancing their design sketches. Our study also sheds many limitations on image AI to facilitate design practice. Specifically, image AI fails to understand the Architectural domain-specific terms; it generates surreal images unsuitable for construction purposes; it's hard for designers to render the exact design in mind. Our study suggests that image AI can be a valuable design resource. We wish to offer insights for image AI-based future design tooling and system building, especially with images as the input.

ACKNOWLEDGMENTS

We would like to extend our sincere thanks to the participants in this study. We thank Accenture Technology Labs and the School of Architecture's Computational Design Research micro-grant for supporting this research. Additionally, we would like to thank members of the CoDeLab for their feedback throughout the development of this project.

REFERENCES

[1] Rinon Gal, Yuval Alaluf, Yuval Atzmon, Or Patashnik, Amit H Bermano, Gal Chechik, and Daniel Cohen-Or. 2022. An image is worth one word: Personalizing text-to-image generation using textual inversion. *arXiv preprint arXiv:2208.01618* (2022).

[2] Jun Gao, Tianchang Shen, Zian Wang, Wenzheng Chen, Kangxue Yin, Daiqing Li, Or Litany, Zan Gojcic, and Sanja Fidler. 2022. GET3D: A Generative Model of High Quality 3D Textured Shapes Learned from Images. https://doi.org/10.48550/arXiv.2209.11163 arXiv:2209.11163 [cs].

[3] Shunan Guo, Zhuochen Jin, Fuling Sun, Jingwen Li, Zhaorui Li, Yang Shi, and Nan Cao. 2021. Vinci: An Intelligent Graphic Design System for Generating Advertising Posters. In *Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems (CHI '21)*. Association for Computing Machinery, New York, NY, USA, 1–17. https://doi.org/10.1145/3411764.3445117

[4] Melissa Heikkiläarchive. 2022. This artist is dominating ai-generated art. and he's not happy about it.

[5] Mina Lee, Percy Liang, and Qian Yang. 2022. CoAuthor: Designing a Human-AI Collaborative Writing Dataset for Exploring Language Model Capabilities. In *Proceedings of the 2022 CHI Conference on Human Factors in Computing Systems (CHI '22)*. Association for Computing Machinery, New York, NY, USA, 1–19. https://doi.org/10.1145/3491102.3502030

[6] Vivian Liu and Lydia B. Chilton. 2021. Design Guidelines for Prompt Engineering Text-to-Image Generative Models. https://doi.org/10.48550/arXiv.2109.06977 arXiv:2109.06977 [cs].

[7] Vivian Liu, Han Qiao, and Lydia Chilton. 2022. Opal: Multimodal Image Generation for News Illustration. https://doi.org/10.48550/arXiv.2204.09007 arXiv:2204.09007 [cs].

[8] Michael Muller, Lydia B Chilton, Anna Kantosalo, Q Vera Liao, Mary Lou Maher, Charles Patrick Martin, and Greg Walsh. 2023. GenAICHI 2023: Generative AI and HCI at CHI 2023. In *Extended Abstracts of the 2023 CHI Conference on Human Factors in Computing Systems*. 1–7.

[9] Han Qiao, Vivian Liu, and Lydia Chilton. 2022. Initial Images: Using Image Prompts to Improve Subject Representation in Multimodal AI Generated Art. In *Creativity and Cognition*. 15–28.

[10] Sarah Shaffi. 2023. 'It's the opposite of art': why illustrators are furious about AI. *The Guardian* (Jan. 2023). https://www.theguardian.com/artanddesign/2023/jan/23/its-the-opposite-of-art-why-illustrators-are-furious-about-ai

[11] Amy Smith, Hope Schroeder, Ziv Epstein, Michael Cook, Simon Colton, and Andrew Lippman. 2023. Trash to Treasure: Using text-to-image models to inform the design of physical artefacts. https://doi.org/10.48550/arXiv.2302.00561 arXiv:2302.00561 [cs].

[12] Amy Smith, Hope Schroeder, Ziv Epstein, Michael Cook, Simon Colton, and Andrew Lippman. 2023. Trash to Treasure: Using text-to-image models to inform the design of physical artefacts. https://doi.org/10.48550/arXiv.2302.00561 arXiv:2302.00561 [cs].

[13] Justin D. Weisz, Michael Muller, Jessica He, and Stephanie Houde. 2023. Toward General Design Principles for Generative AI Applications. https://doi.org/10.48550/arXiv.2301.05578 arXiv:2301.05578 [cs].

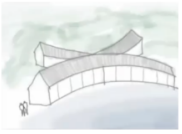
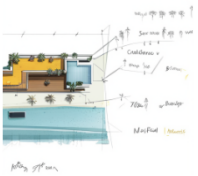
[14] Paulina Yurman and Anuradha Venugopal Reddy. 2022. Drawing Conversations Mediated by AI. In *Creativity and Cognition (C&C '22)*. Association for Computing Machinery, New York, NY, USA, 56–70. https://doi.org/10.1145/3527927.3531448

[15] Lvmin Zhang and Maneesh Agrawala. 2023. Adding Conditional Control to Text-to-Image Diffusion Models. https://doi.org/10.48550/arXiv.2302.05543 arXiv:2302.05543 [cs].

[16] Tianming Zhao, Chunyang Chen, Yuanning Liu, and Xiaodong Zhu. 2021. GUIGAN: Learning to Generate GUI Designs Using Generative Adversarial Networks. In *2021 IEEE/ACM 43rd International Conference on Software Engineering (ICSE)*. 748–760. https://doi.org/10.1109/ICSE43902.2021.00074 ISSN: 1558-1225.

A APPENDIX

A.1 Table of final designs and the correlating prompt.

ID	Final Design	Design Duration	Correlating Prompt	ID	Final Design	Design Duration	Correlating Prompt
P1		54 min	"Building perspective of tropical beachside hotel, timber structure, curve roofline"	P7		50 min	"future, brave new world, 1984, cybernetics, professional architecture rendering"
P2		36 min	"red building with a sea background and lots of trees with frank lloyd wright style" (*Did not generated from image)	P8		53 min	"a large hotel with green roofs on the beach overlooking the ocean. With the addition of a large patio on the beach with giant "HILTON" letters in the style of the famous "AMSTERDAM" letters
P3		48 min	"beach hotel in architecture 3k render style"	P9		74 min	*Original Sketch
P4		58 min	"Realistic sunset view, realistic style, famous luxury hotel on the beach of florida, parametric curvatures in architectural design, organic in form, add people on the beach, 4k"	P10		50 min	"Watercolor image of building with colorful glass"
P5		45 min	"A sketch of a luxurious hotel, an architectural rendering image. Floating in the ocean with 2 yachts, and a helicopter on the sky around to transfer people"	P11		43 min	"a master plan/roof plan of the beachfront hotel design proposal. the hotel has 3 stories, with yellow brick roof and white exterior. on the the second floor, there's a terrace with a swimming pool. in the middle, the brown platform is the entrance and can be also used for outdoor performance stage as well as outdoor cinema activities. the hotel also provide a private beach for their customers, where there's a deck/pier extended to the sea, and water sports zone for fun."

Notes:
*P9 used the original sketch as the final design as they were not satisfied with any AI-generated image
*P2 used an image generated directly from text input (without design sketch input) as the final design

A.2 Interview Questions

Question Number	Topic	Interview Question
Q1	The experience	1.1 Based on your experience working with AI tools, do you think the AI tools work well? Why? 1.2 (If yes) Which aspects of the AI tools do you think works well? Why?
Q2	The challenges	2.1 Have you encountered any challenges using this tool? 2.2 (If yes) What challenges did you encounter? How did you overcome/navigate through these challenges to get the outcome that you wanted? Why did this outcome matter to you?
Q3	The improvement directions	3. Based on the challenges you encountered, in what ways could AI tools improve to better facilitate the early stages of your design processes?
Q4	Incorporating the tool into real practice	4.1 Imagine a recent project you've worked on. Would you like to incorporate the AI tool into this project and your current practice? 4.2 (If yes) Would the workflow be better or worse? What parts do you think it will be better/worse? How would it change how you design? (If no) Why not? Can you tell me the reason why?