

Elaborating a Design Framework That Is Able to Structure and Guide Composition of Generative AI Visualizations

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ABSTRACT

One aspect of using generative artificial intelligence (AI) in design workflows that is not well understood, is how designers navigate the use of prompts and imagery to control design outputs. To learn more about the ways generative AI can elaborate different innovative design aspects linked to a conceptual genre, we undertake an analysis of designer outputs and link these to a mapping of iterative design workflow, and the composition of prompts and imagery used to inform generative AI visualizations. A speculative design workshop presented young designers with a proposed framework to facilitate and guide them through an iterative design process using generative AI tools (Vizcom and Midjourney). Design outputs included designed objects, atmosphere, spatial configurations able to generate social communication and relations for futuristic residential lighting environment. Prompt writing and sketching were two crucial variables that enable high fidelity design visualization. Traditionally research on prompt writing focuses on variables of descriptive design imagery, point of view, quality of output, ordering, precision, tone and style. (Microsoft, 2023) In this study we investigate how designers initiate and continually engage with a generative AI system to achieve consistency of outputs and elaborate design variations. The literature review identifies variables to assess the impact of creative input to structure the generative AI visualizations. Our analysis focus on the cognitive workflows and its ability to integrate a mix of analogical and digital methods(sketching, prompts writing, and digital imagery). The analysis constructs focus on the way the design methods translate different spatial qualities, phenomenal experiences that have potential to facilitate social communication and relations, (proximity, sightline-acoustic comfort). Our insights constructs a design framework to guide prompt composition that inform iterative generative AI outputs. The schematic framework may be used to guide AI generated visualizations according to the qualities of atmosphere linked to the spatial forms and arrangements of interior spaces. Written prompts and imagery are examined in their ability to articulate design principle, spatial qualities, spatial characteristics, spatial forms and social relations.

Keywords: Artificial intelligence, Computational design, Visualization, Speculative design, Iterations, Prompts

INTRODUCTION

One aspect of using generative AI in design workflows that is not well understood, is how designers navigate the use of prompts and imagery to control design outputs. To learn more about the ways generative AI can elaborate different innovative design aspects linked to a conceptual genre, we conduct an analysis based on designers' outputs from a recent speculative design workshop and link these to a mapping of iterative design workflow. The analysis of prompts and imagery used to inform generative AI visualizations is an important aspect of this study. Together the insights gained from this study may be used to structure and guide similar undertakings and composition of AI visualizations that take advantage of different and innovative design thinking strategies. The discussion further considers insights on how designers were able to achieve satisfaction in their ability to translate their ideas with AI in ways that align to their conceptual vision.

METHDOLOGY

This study seeks to answer the following research question: how do designers initiate and continually engage with a generative AI system to achieve consistency of outputs and elaborate design variations? Our analysis begins with a description of the speculative design framework. The analysis is structured by a cognitive design framework to characterize inputs and outputs according to spatial structure and spatial qualities, two aspects of generic abstraction (Middleton, 2024). The analysis focuses on three aspects;

1. The way prompt language is used to inform the AI structure of the visualization.
2. The analysis identifies two aspects seen in the visualization outputs that demonstrate the relationship of spatial structure and spatial quality in the AI constructed visualizations.
3. Visualization quality is then assessed with consideration of fidelity and consistency across the iterative visualization sequence.

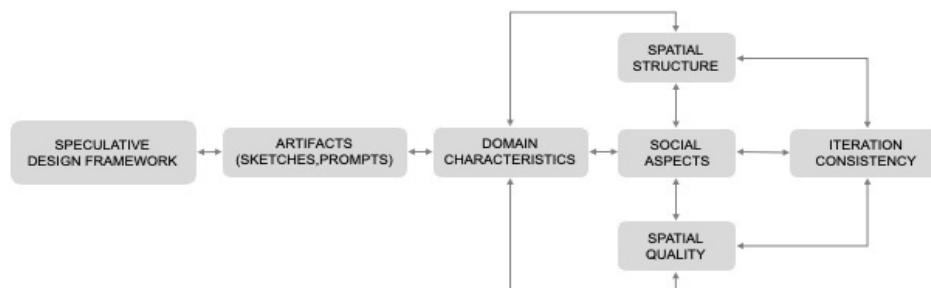


Figure 1: Framework analysis.

SPECULATIVE DESIGN FRAMEWORK

A workshop “The Quality that Lights Up”, was held on a Chinese university to investigate possible futures of lighting, it was structured as two phases: phase I *Vision* and phase II *Solution*. In phase I designers collaborate in teams and access the virtual platform, *Miro* to share ideas and strategic foresight about the future of lighting (Fig. 3). This speculative design process follows a methodological approach (Balagtas, 2019, Candy, 2018) to research drivers, trends and identifying focal issues, (Santer, 2019) and construct futuristic scenarios archetypes. (Fergnani, 2019) The scenario archetypes were used to structure further analyses and shape probable spatial outcomes with lighting experiences. The initial workshop structure (Fig. 2) was organized into two phases of five days each, with the first phase focusing on defining a vision and the second phase articulating the materialization of solutions. A probability impact matrix was used to organize the analysis of trends research and design priority guiding designers to engage in the planning of scenario archetypes and to frame a design future within a specific time horizon of ten years. Designers then use analogical and digital methods: hand sketches, post-it pin-up, storyboard, physical space configurations to translate their design intent and provide input into the AI tools.

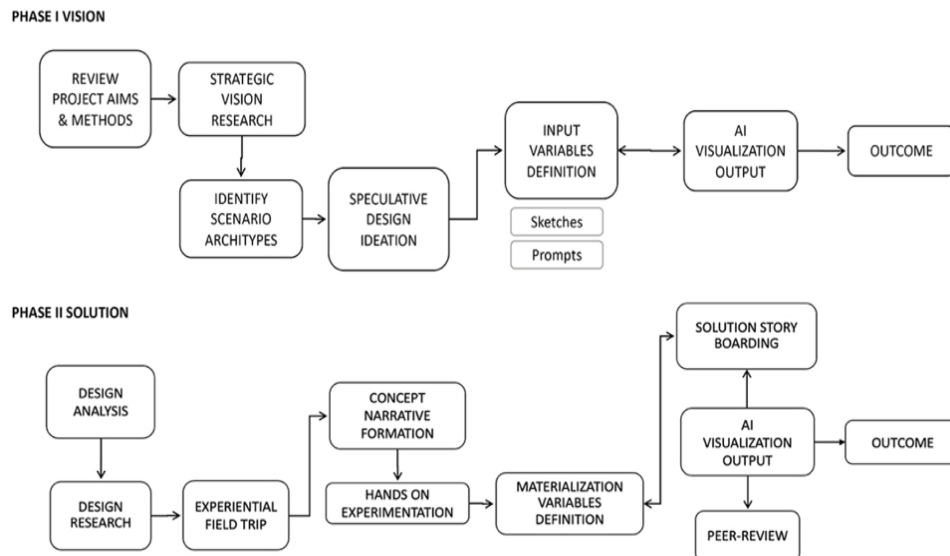


Figure 2: Workshop workflow across two phases (ten days).

ANALYSIS AND FINDING

Two examples of designers informed iterative processes are shown below. The young designers were asked to visualise their idea through different AI tools. This is shown below as inputs of prompt and sketch and outputs of AI visualizations.

Table 1. Workshop outcome sample designer 1 phase I using AI Vizcom.

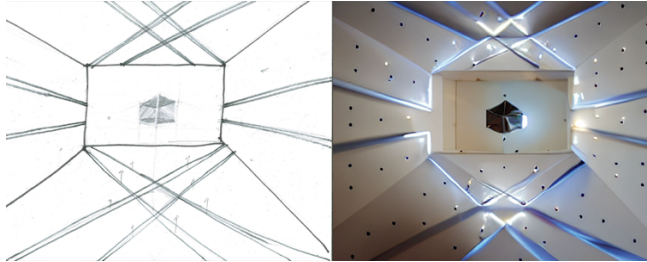

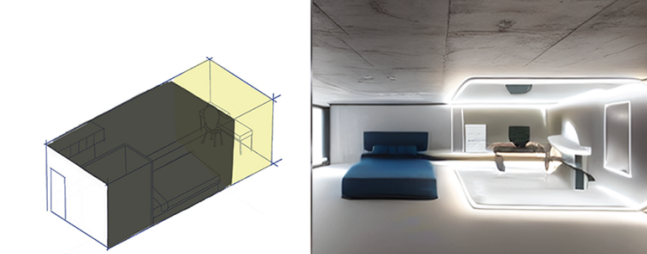
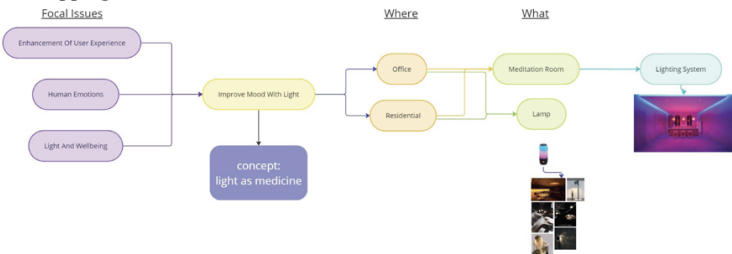
Prompt	AI Iteration
<p>CONCEPT A</p> <p>White led strips in a room making a shadow cube.</p>	
<p>CONCEPT B</p> <p>Man working with his laptop on the right side of the room with bright light, on the left side of the room which is very dark.</p>	
<p>CONCEPT C</p> <p>In 2033, futuristic smart AI will light up the study space. The Ai smart light can be half dark half-light, it gives different lighting for different space.</p>	
<p>Designer mind mapping</p> 	
<p>Analysis and Findings</p> <p>Starting from researching and analysing lighting phenomena to enhance user experience connected to human emotion, the student utilize Vizcom as AI design tool, the designer used a combination of sketches and prompts to generate images, Through an AI domotic system light became a medium to divide spaces to enhance user experience needs. The use of sketches combined with prompts helped him to quickly visualize his design intent and create different constructs based on his idea that has been translated thanks to the AI into spatial artifacts.</p>	

Table 2. Workshop outcome sample designer 1 phase II using Midjourney.

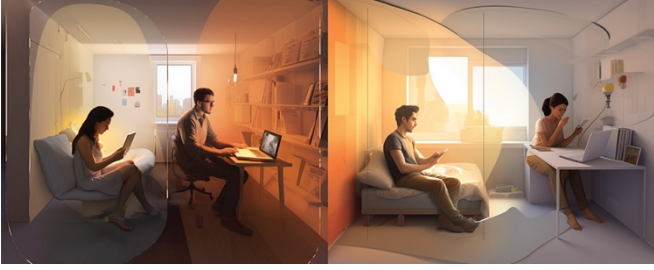



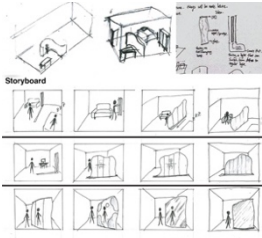

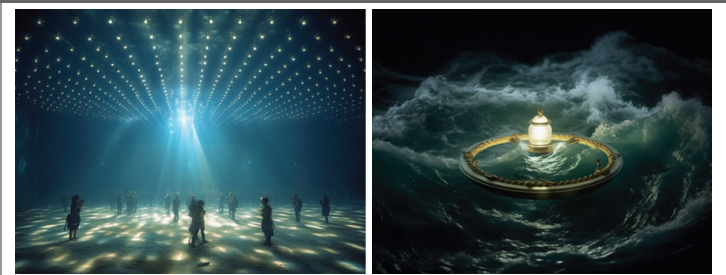
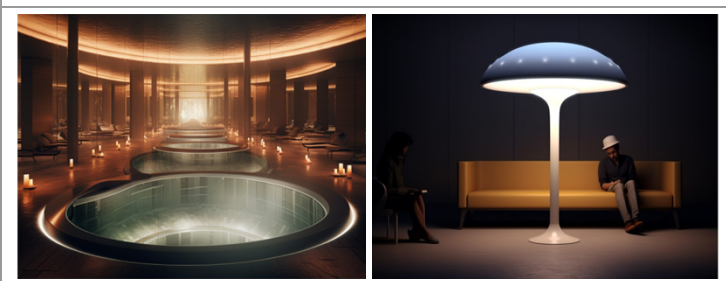
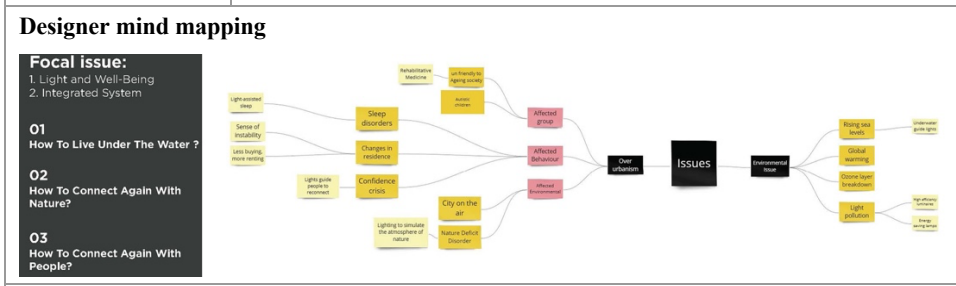
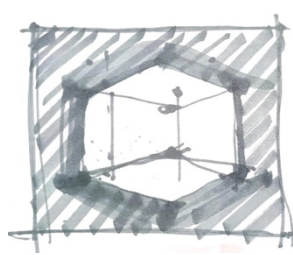
Prompt	AI Iteration
<p>CONCEPT A</p> <p>Making partitions with light to divide living spaces to increase small living spaces.</p>	
<p>CONCEPT B</p> <p>Light partition system to adjust its lighting to improve user's mood and wellbeing.</p>	
<p>CONCEPT C</p> <p>2 people working in the same room doing different activities divided by a partition emitting 2 different kinds of light.</p>	
<p>CONCEPT D</p> <p>An apartment room with people doing different activities and a partition made of light separating their spaces and shining lights of different colours.</p>	
<p>Storyboard</p> 	
<p>Designer Workflow</p> <p>Analysis and Findings</p> <p>The designer envisions a future where the lighting system is already capable to interact with human behaviour. Starting from the analysis of present technologies and human centric lighting systems, the student first iterations was to developed smart furniture able to interact with the surroundings (spatial structure), the human moods and behaviours. In the final visualization he scaled up to a system, where AI controls lightings to improve user's mood and wellbeing in the base of different scenarios and activities (spatial quality), and social interaction (social quality) achieving an excellent consistency level in all the iterations.</p>	

Table 3. Workshop outcome sample designer 2 phase I using Midjourney.

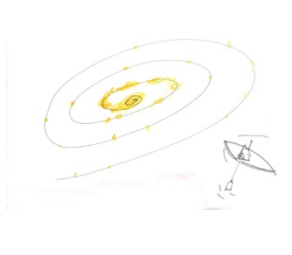
<p>UNDER THE SEA Bright big light field in a deep sea created by many rays of light, rectangular area field, bulbs on the corners of this field, shining field under the sea, people wearing diving suits dancing inside this shining block, high-resolution photo, photography, 8K --s 250 (A)</p>	<p>STORMY WEATHER A lamp showcases the flow velocity at the centre of a whirlpool in the middle of the sea, 8k, photography style, --ar 4:3 (B)</p>
<p>PREMIUM SPA Venue with a hot spring pool in the middle, the water in which is completely evenly illuminated. --s 250</p>	
<p>PRODUCT DESIGN A lamp used for helping people communicate with each other in 2030, --ar 4:3 --s 250</p>	




Designer research and synthesis



Design a light, so that it can form a regular shape of the sea floor space, creating a field of the occasion, so that people choose any place they want to activity, but also can arbitrarily change the shape of this place.




A light can be designed so that the stronger the light is in the place where the flow is high, which can help the people traveling on the bottom of the sea, or on the surface, even if the risk is anticipated and avoided.



Keeping land creatures, like fireflies, in the form of lights keeps people remembering and sensing their presence.

Analysis and Findings
The designer investigated different futuristic scenarios of human habitat and managed to develop multiple circumstances of how people will interact with the environment thanks to different lighting phenomena (spatial quality). The different iterations are very imaginative showing already advanced prompts composition skills in detailing image format, focal cameras and image quality, demonstrating a great ability to control the AI tool for translating the strategic vision into a design visualization, with a high consistency level.

Table 4. Workshop outcome sample designer 2 phase II using Midjourney.

Prompt	AI Iteration
<p>CONCEPT C</p> <p>There is a spa pool on the floor where people lie and float;The atmosphere is very much like being in nature, but there are no trees around, natural environment on the wall as hologram 16k HD --ar 16:9</p>	
<p>CONCEPT B</p> <p>One spa room has glowing ring lights above it, releasing green mist, and the water in the pool is green in the middle and yellow on the outside, giving it the feel of a natural lake 16k HD --ar 16:9</p>	
<p>CONCEPT C</p> <p>A small circle optical lens suspended in the air emits a vertical beam of light downward in a modern living room 16k HD --ar 16:9</p>	
<p>CONCEPT D</p> <p>One spa room has glowing ring lights above it, releasing green mist, is evenly illuminated, giving it the feel of a natural lake 16k HD --ar 16:9</p>	
<div style="display: flex; align-items: center;"> <div style="flex: 1;">  </div> <div style="flex: 2;">  </div> </div> <p>Designer workflow</p>	
<p>Analysis and Findings</p> <p>The designer explores the topic of wellness in architecture using lighting to create an immersive experience. The proposed system envisions the future possibility of use a combination of salt and water as an energy source or simply as medium for lighting. The prompt iterations show the process of research and experimentation in the composition of futuristic spatial aesthetics with certain spatial quality and a good level of consistency with the design intent.</p>	

CONCLUSION

One of the outcomes requested to the designers was to maintain the control over their idea without falling into the easy fascinations given by the images iteration generated from the different AI tools (Vizcom and Midjourney), focusing on obtaining consistency between their research conclusion, vision and AI outputs. Our analysis first began by contrasting the input and output between Vizcom and Midjourney.

In the first sample Tab. 1, following the speculative design analysis, the designer started his investigation with Vizcom (workshop phase I) utilizing sketches, as analogical source, and prompts to instruct the AI tool; the result were quickly iterated, (one day, without any previous knowledge of the AI tool), and suitable results were produced for final selection. In the Tab. 2 (workshop phase II), the designer utilized Midjourney for his outcomes. In his investigation process, prompts and the images iterations were the main inputs to instruct the AI; the designer utilized the AI tool as a smart assistant to engage and develop his design idea. The four different iterations shows how thanks to the proposed framework and workflow the young designer was able to scale up his idea from a smart furniture to an integrate design system.

In the second sample Tab. 3 and Tab. 4, the designer preferred to use Midjourney in both workshop phases, the investigation conducted during the speculative design analysis helped to instruct the AI tool with clear information. The designer had already some basic knowledge of the AI tool and this is reflected in the advanced prompts composition. During the workshop phase I, the outcomes are diversified in four different scenarios, the AI tool was used to quickly translate the different investigations into design visualizations. During the workshop phase II, the designer were instruct to focus on one of this futuristic scenario and developed it. As show in Tab. 4 the iterations and prompts composition reflect the different stages of the creative process, the AI tool were used to explore different feasible design outcomes.

The second form of analysis is structured by the cognitive design framework to characterize inputs and outputs according to spatial structure and spatial qualities, two aspects of generic abstraction. The way this spatial constructs were formed in prompts and sketches to instruct AI tools to translate them into visual inspiration to achieve tangible and consistent design results. The aim of this research is to provide an insight into how, using a structured framework, it is possible to use design conception and enable designers to instruct and inform AI tools. The analysis demonstrates how designers were capable to maintain control of AI visualization and satisfy their design intent. The main challenges of this workshop for the facilitators was to create a framework able to combine the proposed speculative design charette in combination with hyper-interactive spaces (Albano et al., 2024), and find suitable AI visualization platforms that would work with designer inputs, sketches and prompts (analog and digital), to generate AI outputs consistent with their design intent. One of the findings is that more proficient designers became in composing the prompts commands the better the design outcomes became. The rapid learning curve demonstrated by young designers to use and refine

AI images through this constructed framework, led to increase the iterative design cycles and generated excitement to structure prompts syntax. This process was inspirational and capable to translate their idea, starting from generic abstraction, into design results with great consistency and immediacy. We can conclude that any design process produces more effective outcomes when the instructions are clear; thus, through a combination of a structured framework and a skilled use of AI tools designers were able to achieve a satisfactory level of consistency, increase their productivity, and explore more creative and aesthetic aspects.

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