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The Exploration of Integrating the Midjourney Artificial Intelligence Generated Content Tool into Design Systems to Direct Designers towards Future-Oriented Innovation

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Abstract: In an age where computing capabilities are expanding at a breathtaking pace, the advent of Artificial Intelligence-Generated Content (AIGC) technology presents unprecedented opportunities and challenges to the future of design. It is crucial for designers to investigate how to utilize this powerful tool to facilitate innovation effectively. As AIGC technology evolves, it will inevitably shift the expectations of designers, compelling them to delve deeper into the essence of design creativity, transcending traditional sketching or modeling skills. This study provides valuable insights for designers on leveraging AIGC for forward-thinking design innovation. We focus on the representative AIGC tool, "Midjourney", to explore its integration into design systems for collaborative innovation among content creators. We introduce an AIGC-based Midjourney path for product design and present a supporting tool card set: AMP-Cards. To confirm their utility, we undertook extensive validation through advanced prototype design research, task-specific project practices, and interdisciplinary collaborative seminars. Our findings indicate that AIGC can considerably enhance designers' efficiency during product development, especially in the "explorative product shape" phase. The technology excels in identifying design styles and quickly producing varied design solutions. Moreover, AIGC's capacity to swiftly translate creators' concepts into visual forms greatly aids in multidisciplinary team communication and innovation.

Keywords: AIGC; designer-AI collaboration; interdisciplinary cooperation; future-oriented design

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1. Introduction

In the burgeoning realm of Artificial Intelligence Generated Content (AIGC), we are witnessing a technological evolution that transcends the traditional production limitations of designers, paving the way for unparalleled capabilities in limitless content generation. Currently, the applications of AIGC extend from media and education to entertainment, marketing, and scientific research, highlighting the technology's potential to provide users with high-quality, efficient, and personalized content services [1]. The progress in AIGC is set to reshape the working methods of designers and influence collaboration modes in the design industry. Several artificial intelligence (AI) tools are increasingly impacting the design arena. For instance, the ChatGPT chatbot can engage in logical conversations and produce self-initiated copywriting, novels, scripts, and essays, thus enhancing human–computer interaction [2–6]. Another example is the Stable Diffusion AI painting model, which obtained several prizes at international art competitions for the works it has created [7]. Midjourney, rooted in the Stable Diffusion AI painting paradigm, is a text-driven image generation tool. With just a textual prompt, it can generate the corresponding image in approximately one minute. Midjourney harnesses the synergistic collaboration between human intuition and machine intelligence, empowering both specialized content creators and the broader audience to envision and craft beyond the traditional confines

of "technology" and "efficiency" [3,8]. The recent iteration, Midjourney 5.2, introduces features such as object locking, partial redrawing, and drawing style selection, broadening its applicability across various domains, including product design, animation, gaming, and fashion. Furthermore, it consistently delivers images of leading quality and creativity [3].

As an embodiment of technological advancement and intellectual progress, AI guides designers to transform into intelligent designers. The rapid evolution of AI positions it as more than just a tool for design; it also manifests a degree of creativity, sparking debates around the question "Will AI replace designers"? We contend that the relationship between AI and human designers should be seen as complementary rather than substitutive. A synergy of "human intelligence + artificial intelligence", or "fusion intelligence", is likely to emerge [9]. AI acts as a collaborative partner, establishing a symbiotic relationship with designers and steering their innovative thinking systematically [10–12]. In the case of Midjourney, the tool has made a breakthrough in the basic modules of AI co-design and has been successfully integrated into the design innovation process. Here, we employed the Double Diamond model, a structured and iterative approach to describe the design process as Define (Design Definition), Discover (Design Research), Develop (Design generation) and Deliver (Design Implementation). As we can see from Figure 1, the Midjourney AIGC tool plays a key role in the two critical phases of design research and conceptual design, enabling rapid visualization and facilitating efficient communication across multidisciplinary contexts. For researchers, Midjourney's rapid visualization capabilities offer a novel research tool that stimulates ideas, supports morphological studies and improves the efficiency of trials. For companies, Midjourney is instrumental in enhancing design efficiency. Its use of the Vincennes diagram provides a new way of expressing the needs of both parties A and B. At the same time, Midjourney significantly reduces the cost of software learning for designers, lowers the barriers to design expression, and boosts the communication efficiency of interdisciplinary teams. With the collaboration of AI, the design process will become more systematic and efficient, allowing designers to delve deeper into design research [13]. This will enable them to integrate knowledge from various disciplines to build an understanding of key interdisciplinary challenges and better equip them to tackle future design problems [14].

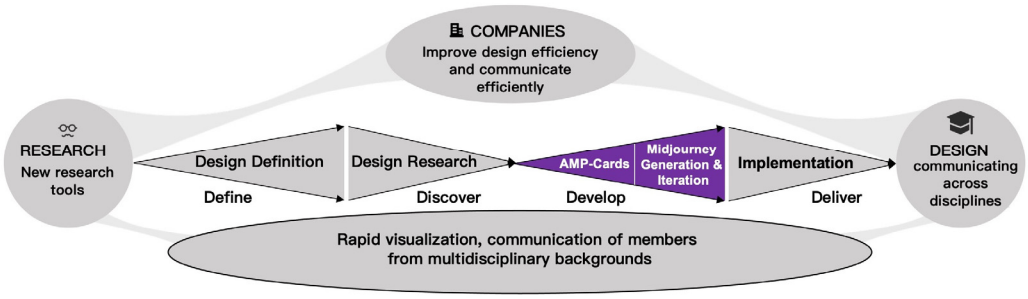

Figure 1. Midjourney's impact on design processes.

This paper aims to investigate how the Midjourney AIGC Tool can be integrated into design innovation systems to equip designers with future-oriented design literacy across different forms of product innovations and interdisciplinary collaborations. Specifically, we explore the following three research questions:

- RQ1: How does AIGC assist designers in developing leading-edge exploratory product design innovations?
- RQ2: How does AIGC rapidly empower designers to focus on task-oriented product design practices?
- RQ3: How does AIGC facilitate the communication of interdisciplinary collaboration in design innovation?

Section 2 presents how to use the Midjourney tool for design practice in four steps, while Section 3 covers the Discussion, followed by the Conclusion in Section 4.

2. Methods

We selected the AI drawing tool Midjourney as an example to demonstrate how AIGC can collaborate and innovate with designers in design practice. This process can be divided into the following four main steps:

- Step 1—Introduction of AMP-Cards: Propose the formula-based AIGC Midjourney Prompt cards for product design;
- Step 2—Conducting leading-edge exploratory program practices: Develop product design concepts through prototype-based design research;
- Step 3—Undertaking enterprise design task-oriented project practice: Delve into how AIGC empowers designers to advance their design practice through examples of projects.
- Step 4—Hosting interdisciplinary collaborative design workshops: Investigate the influence of AIGC on interdisciplinary collaboration for design innovation through a design workshop, and gather participants' feedback through interviews.

2.1. Step 1: AIGC-Based Midjourney Prompt Cards for Product Design

Midjourney is a generative AI service that creates images from natural language descriptions called prompts; therefore, it is important to give the right command. Figure 2 summarizes our Midjourney usage as follows: (1) input two style migration reference maps and generate a fusion map; (2) combine the fusion map with the Prompt formula; (3) select the intended solution; (4) iterate on the intended solution using the Prompt formula; (5) select the final solution.

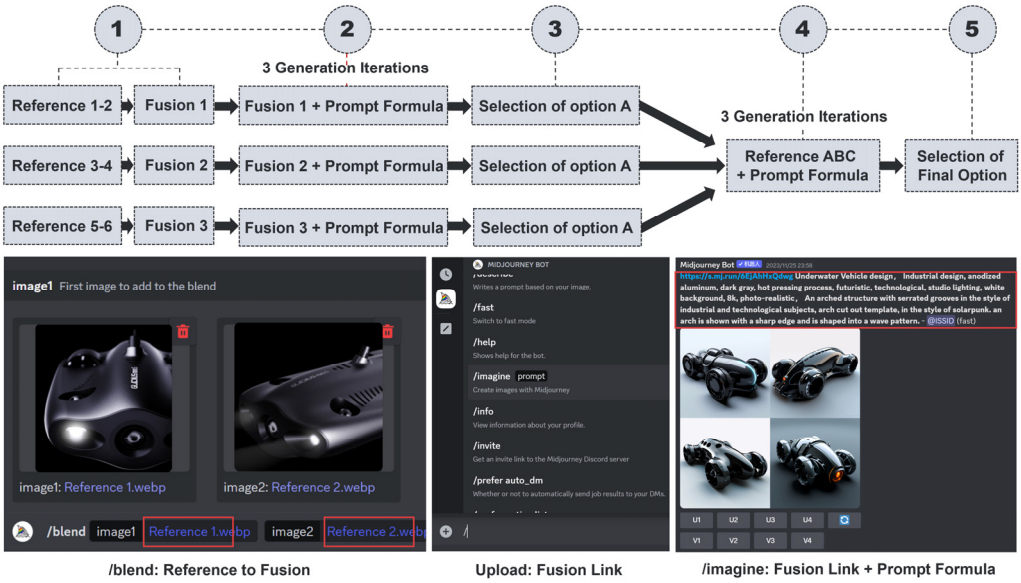

Figure 2. Midjourney usage flow.

The standardization and accuracy of the prompt considerably influence the quality of the images generated using Midjourney [15]. Based on the literature review [16–18] and our team's hands-on experience, we propose the following product design formula:

Reference Image + Target Product (sound design) + Design Discipline (industrial design) + CMF (anodized aluminum, cold stamping) + Designism (modernism) + Designer/Brand (Ditramus/Apple) + Camera View (side view) + Background (white background) + Rendering Method (OC rendering/virtual rendering) + Lighting (global lighting) + Sharpness (4K).

In addition, using the prompt formula combined with many practical experiences, a set of application cards—AIGC-based Midjourney Prompt Cards for Product Design (Figure 3)—were created. These cards offer a convenient tool for novice Midjourney designers to progress from product concepts to product forms by providing succinct

guidance. Experienced designers can also use this card template to create and grow their work area, which requires a Prompt card.

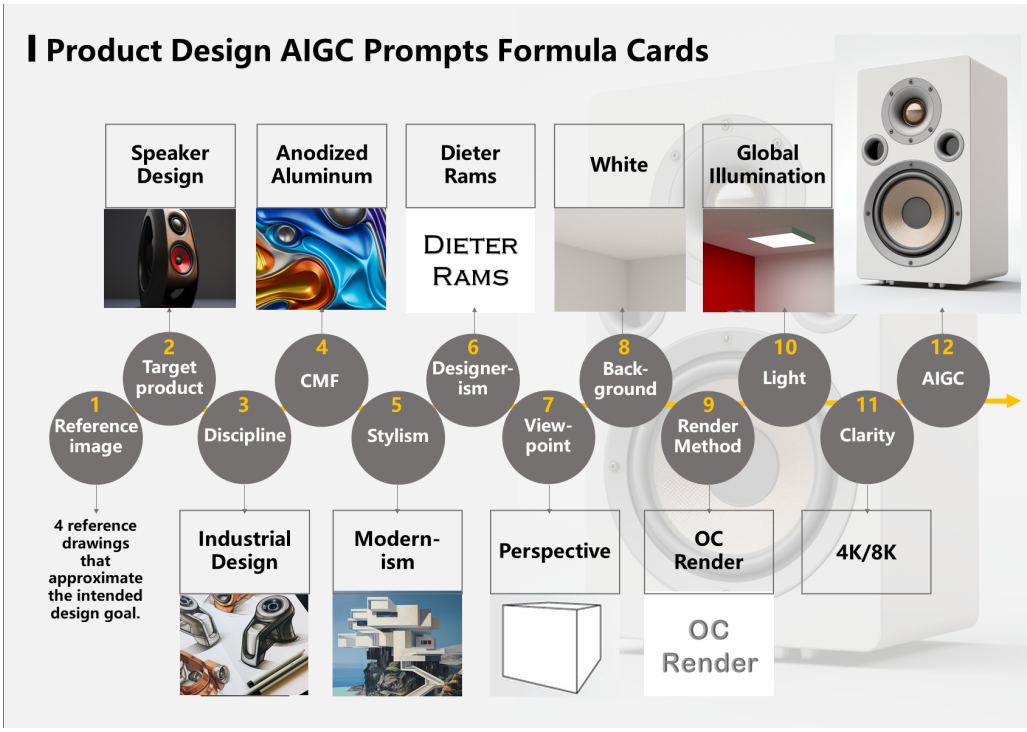

Figure 3. AIGC-based Midjourney Prompt Cards for Product Design (AMP-Cards). Note that all the images within the cards are created by Midjourney.

AMP-Cards can be expandable based on their creators' accumulated AIGC application experience. To facilitate the expansion of their own product design AIGC Prompt card, we have summarized and sorted a number of keywords that are strongly related to product design and affect the quality of generation (Table 1) so that creators can quickly generate the desired design solutions via Midjourney [19,20].

2.2. Step 2: AIGC Empowers Product Design Innovation for Leading-Edge Prototyping Exploration

Future design is increasingly focusing on the integration and innovation of design systems. The demands on designers' qualifications are no longer confined to their design skills; instead, there is a greater emphasis on understanding design systems, that is, the fusion of multidisciplinary knowledge and abilities related to design. Consequently, designers are more likely to engage in design research from an interdisciplinary perspective, uncover deeper layers of design inspiration, and create innovative designs rich in principled qualities. With the aid of AIGC collaborative design, designers can conserve more energy to focus on researching design inspirations, particularly those stemming from the real world, for example, bionics. By delving into other fields, they are able to uncover design inspirations across a broader spectrum.

Utilize a design application based on the study of the morphology of pearl scallops to demonstrate how AIGC can assist designers in conducting design innovations for cutting-edge prototyping explorations. We analyzed existing research on pearl scallops, with a particular focus on the unique structure that has evolved to adapt to a hostile environment. Using Canny edge detection, we processed forty-nine scallop images from Figure 4a for edge extraction. As a result, two morphological patterns were identified and are presented in Figure 4b. In this process, we utilized parametric design for shape fitting and regularity validation, paving the way for Midjourney generation.

Table 1. AIGC Collaborative Industrial Design Strong Keywords Library.

Materials	Processing	Designism	Designer
Anodized aluminum	Super plastic molding	Modernism	Dieter Rams
Carbon fiber	Injection molding	Deconstructionism	Raymond Loewy
Stainless steel	Blow molding	Postmodernism	Charles and Ray Eames
Ceramic	Extrusion molding	Minimalism	Philippe Starck
Glass	Rotational molding	Maximalism	Jonathan Ive
Acrylic	Thermoforming	Functionalism	Karim Rashid
ABS plastic	Die casting	Constructivism	Marc Newson
Polycarbonate	Sand casting	Futurism	Naoto Fukasawa
Nylon	Investment casting	Brutalism	Ross Lovegrove
Leather	Lost-wax casting	Expressionism	Richard Sapper
Wood	Vacuum casting	Surrealism	Patricia Urquiola
Concrete	Metal spinning	Abstract expressionism	Jasper Morrison
Silicone	Hydroforming	Pop art	Ingo Maurer
Rubber	Compression molding	Art deco	Yves Behar
Brass	Transfer molding	Constructivism	Marcel Wanders
Copper	Foam molding	Post-structuralism	Alfredo Häberli
Bronze	Hot forging	Structuralism	Hella Jongerius
Zinc	Cold forging	Eclecticism	Tom Dixon
Titanium	Roll forging	technocracy	Konstantin Grcic
Gold	Coining	Art nouveau	Stefan Sagmeister
Silver	Swaging	Arts and crafts	Sam Hecht
Platinum	Wire drawing	Environmentalism	Tadao Ando
Nickel	Deep drawing	Humanism	Peter Eisenman
Tin	Spinning	Rationalism	Bjarke Ingels
Iron	Bending	Primitivism	Zaha Hadid
Alloy	Roll bending	Neo-classicism	Norman Foster
Epoxy	Hydro bending	Neo-expressionism	Jean Nouvel
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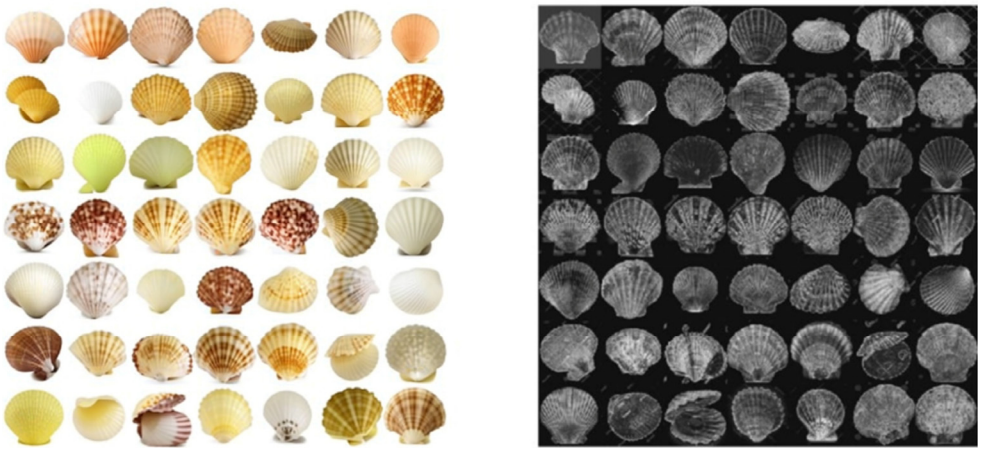

(**a**) (**b**)

Figure 4. Pearl shell image processing: (**a**) Pearl Scallop Image Collection; (**b**) Edge detection.

Pattern 1: The shells feature arched rather than semicircular ridges, interspersed with tiny grooves as depicted in Figure 5, a design that enhances their resistance to pressure. To analyze this particular shape, we employed Ameba, a topology optimization plug-in for Rhino 7.4 modeling software, validating the morphology based on the modeled structure. We discovered that the arch shape plays a significant role in improving pressure distribution upon ground contact. Furthermore, after 59 iterations of bidirectional evolutionary structural optimization (BESO) applied to the arch shape, a fine groove structure emerged on the ridge. This structure bears a resemblance to the parallel arrangement seen in the pearl oyster, substantiating the validity of Pattern 1.

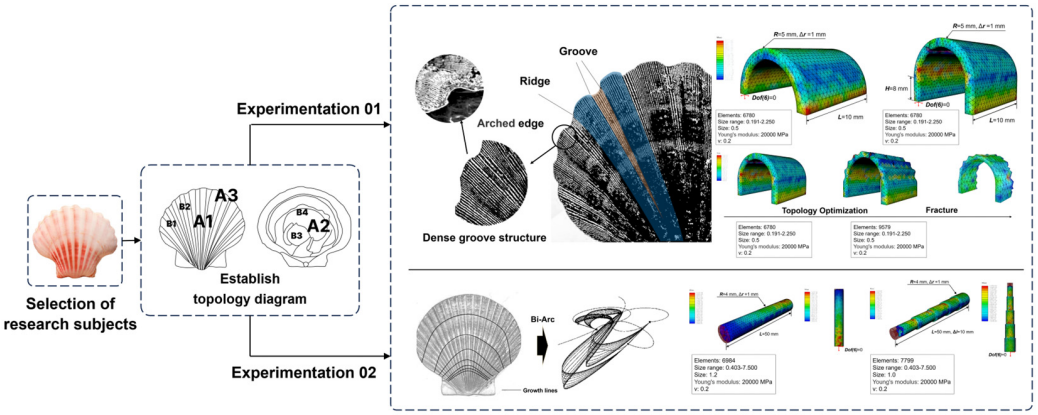

Figure 5. Morphological study of pearl scallops. After selecting the subject, we created a topological diagram to illustrate the scallop's hierarchical structure: Level 1 (A) and Level 2 (B, components of A). The pearl scallop is divided into shell A1, soft part A2, and eye A3. Shell A1 further splits into ridge B1 and groove B2, while the soft part is divided into muscle B3 and gill B4.

Pattern 2: The fan-shaped growth pattern of pearl scallop in dividing the ridge and groove, in contrast to the traditional concentric fan with increasing radius of equal difference, tends to encrypt from the outside to the inside gradually, and this structure effectively reduces the problem of pressure concentration. In this case, the circular interpolation blending algorithm was applied to simulate the variation of growth pattern sparsity by fitting the morphology. With Rhino modeling software, we built a classic curved shaft structure, and then with the Ameba plug-in, we performed finite element analysis to verify this structure [21,22] (Figure 5).

The morphology of the pearl scallop served as inspiration for the design of the submarine, an artificial underwater product. We applied AMP-Cards and entered the following keywords in Midjourney: Autonomous Underwater Vehicle design, Industrial design, anodized aluminum, dark grey, hot-pressing process, futuristic, technological, studio lighting, white background, 8k, photo-realistic, an arched structure with serrated grooves in the style of industrial and technical subjects, arch cut out template, in the style of solarpunk. An arch is shown with a sharp edge and is shaped into a wave pattern. Figure 6 displays the specific generation process: restricted by six references, three series of conceptual design generation attempts were first made, followed by selecting the three preliminary solutions. Using the "/blend" command of Midjourney, the three solutions were combined and iterated to generate the final solution. This solution emphasizes the structure of the pearl scallop ridges and incorporates grooves in the center protrusions to enhance the shell's strength. The external structure is semi-closed, and the edge morphology reflects the irregular margins of the pearl scallop.

The case above demonstrates the collaborative impact of AIGC, as exemplified by Midjourney, in the rapid visualization (transformation) of design inspirations into conceptual design solutions. It can efficiently generate multiple abstract solutions for designers, significantly reducing designers' workload in the 'shape-making' phase of conceptual design. This efficiency enables designers to devote more time [23] and energy to inspiration research, stimulates deeper innovation capabilities, and promotes interdisciplinary collaboration to solve more complex problems [24] (Figure 7). This approach to AIGC co-design may serve as a model for industrial designers' future methods of operation [25,26].

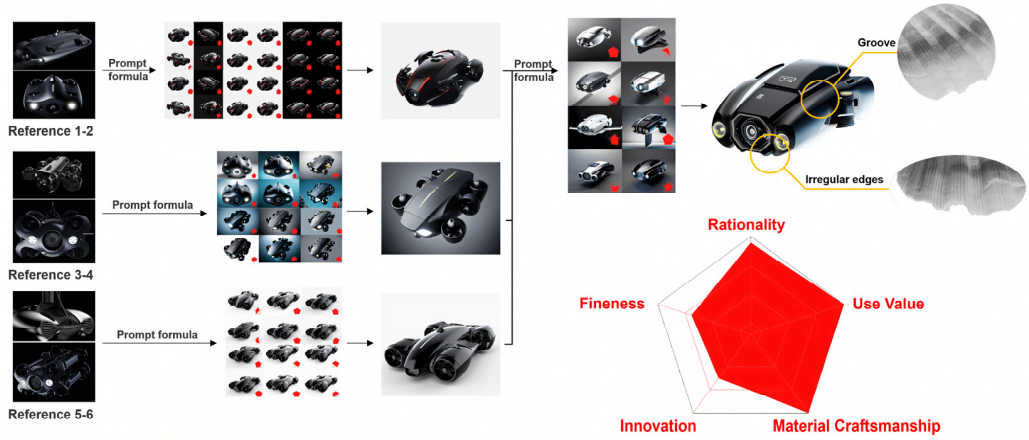

Figure 6. Submarine design based on pearl scallop morphology study under AIGC collaboration. Five dimensions are proposed to evaluate the AIGC generation results from a morphology design viewpoint.

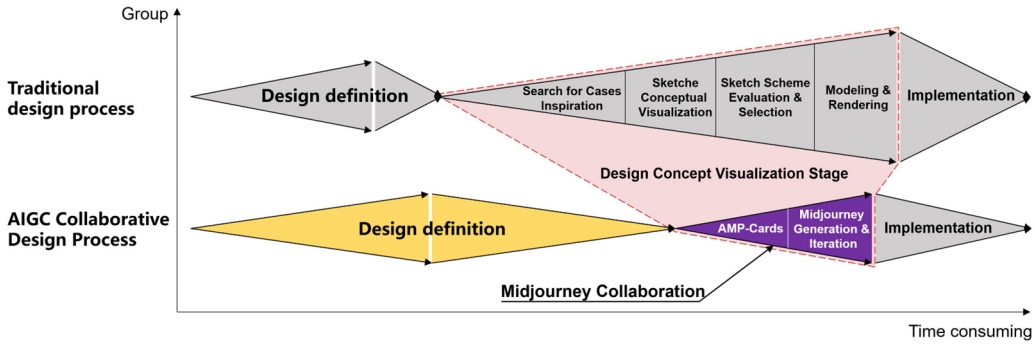

Figure 7. Improvement in design efficiency by AIGC collaboration.

2.3. Step 3: AIGC Assists Companies in Designing Task-Oriented Practice Programs

AIGC boasts significant advantages in mastering design styles and rapidly outputting multiple solutions, facilitating the swift and iterative progress of company-commissioned designs, particularly in projects with a focus on styling [27]. Taking Midjourney as an example, the success of a design relies on two key factors: (i) identifying and uploading a reference that aligns with the desired design style in accordance with the company's specifications; (ii) inputting the appropriate prompt for AIGC to generate logic. The prompt serves as the primary means of interaction between designers and AIGC, and selecting the correct prompt words is crucial to maximizing AIGC's efficiency, enabling it to quickly generate a plethora of design solutions for designers to select.

We present a case study of Flying Aerospace (Beijing)'s flying vehicle design, in which the conventional vehicle is equipped with the capability for vertical take-off and landing (eVTOL), in addition to its standard ground operations. The company's main design requirements for this project include (i) an appealing stylish design with a feasible structure; (ii) a transition to the Tesla Cybertruck design style; (iii) completion of the design within twenty-four hours. After analyzing the 'impenetrable exoskeleton' styling sensibility of the Cybertruck we converted its design elements—such as morphological style, materials, and color scheme—into textual descriptions to prepare for composing the prompt. AIGC-Midjourney and our design team collaboratively worked on the exterior. To enhance the accuracy of the prompt, we used Midjourney's "/describe" command to input an image of the Cybertruck, allowing the AI to extract its stylistic elements. Additionally, we used AMP-Cards to input the prompt alongside the design concept: Flying car design, industrial design, black and white split, cold stamping, modernism, futurism, Tesla, perspective, white background, OC rendering, studio lighting, 4K. Within 20 min, we collaborated with Midjourney to conduct two rounds of iteration and generate 26 solutions. Based on a derived proposal that closely aligned with the company's design requirements, we exported

the STEP model, making modifications and manual adjustments based on the designer's experience (Figure 8). It took only 10 h from the receipt of the project requirements to the completion of the design proposal, which the company approved on the first iteration. The company design task-oriented practice project demonstrates that AIGC collaborative designers can substantially enhance product design efficiency.

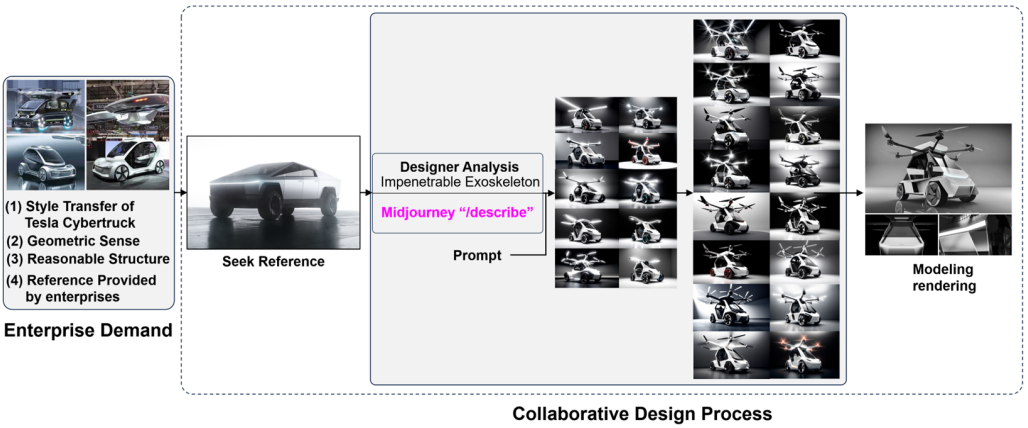

Figure 8. Modular flying car design based on the collaboration of prompt formulas.

2.4. Step 4: AIGC Facilitates the Future of Design Innovation through Interdisciplinary Collaboration

Future design projects require interdisciplinary and multi-professional collaboration. However, previous projects [28] have demonstrated that achieving efficient communication and effective teamwork within interdisciplinary teams is invariably a challenge. Due to distinct fields of specialization, the lack of mutual understanding of the different knowledge backgrounds in traditional interdisciplinary cooperation results in high communication costs and slow project progress [29–31]. For example, students without a design background might lack the necessary sketch drawing skills to visually present their ideas to other group members, resulting in miscommunication issues due to their diverse professional backgrounds. The advent of AIGC presents an opportunity to transform the design process and potentially positively influence interdisciplinary team collaboration [32]. Therefore, we conducted a workshop on interdisciplinary collaborative design with AIGC synergy to observe the role of communication between members of Midjourney and AMP-Cards in multidisciplinary collaborations and to explore a new model of interdisciplinary collaborative design resulting from the introduction of AIGC [33].

For this workshop, 12 students were recruited and divided into two groups. Each group consisted of four Mechanical Engineering students and two Industrial Design students. Group 1 engaged in co-design with AIGC-Midjourney, whereas Group 2 followed the conventional design process. The workshop project was based on the XY dual-axis mechanical platform derivative product concept idea.

Group 1 discussed the design definition with all group members in the pre-conceptual design stage. Each group member combed through the AMP-Cards to devise a Prompt based on the design definition and then input the Prompt into Midjourney to obtain the generated design images. Following the generation of design drawings, the group members discussed the scheme and further optimized the Prompt cue words for the iteration. This interdisciplinary communication model for "idea visualization + language expression" could ensure that design solutions are rapidly iterated under a unified concept, markedly enhancing the efficiency of progression. Utilizing the "idea visualization + language expression" approach, students from both disciplines were able to grasp each other's design intentions intuitively, facilitating discussions on design details without the risk of misinterpretation often associated with abstract language expression.

Group 1 designed a solution for fast food in urban areas, proposing the idea of a customized hamburger vending machine. The burger consists of multiple layers of pre-cooked ingredients, catering to different diners' preferences. The vending machine is

equipped with a flexible hand on the XY platform to grab the corresponding elements and "make" the burger ingredients on a central platform, and the burger production process is visible to demonstrate the quality and freshness of the ingredients. Utilizing tools such as Midjourney and AMP-Cards, the team members efficiently worked through five rounds of conceptual solutions (see Figure 9), employing the "idea visualization + language expression" approach (illustrated in Figure 10). The entire design process was completed in approximately three hours.

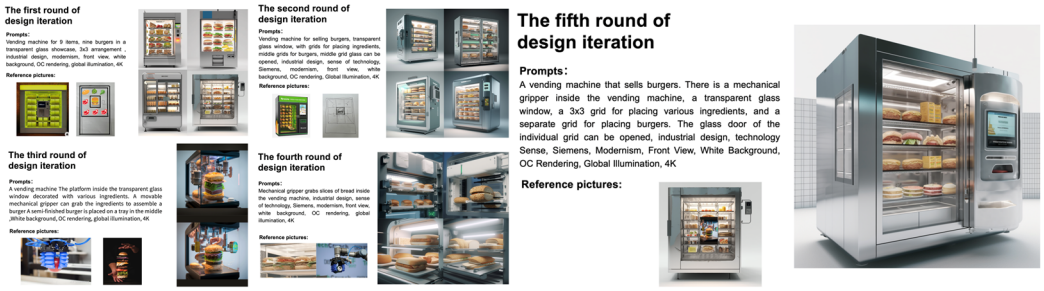

Figure 9. The first set of 5-round iterative design solutions based on Midjourney + AMP-Cards.

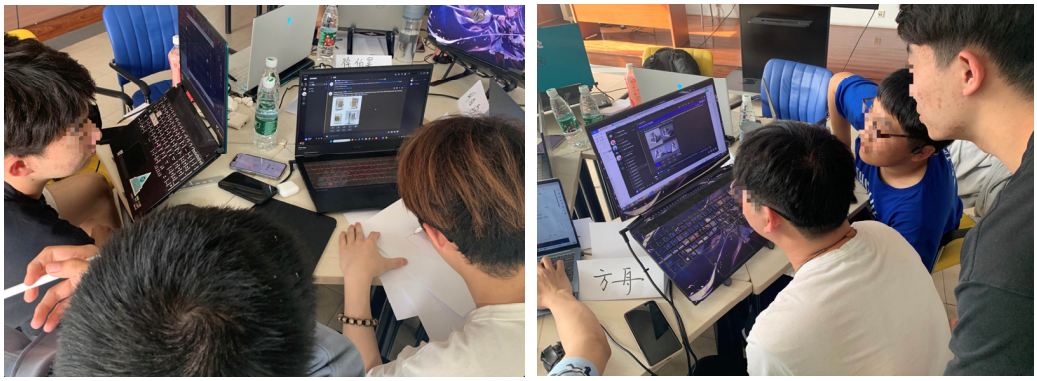

Figure 10. The first group of AIGC-based collaborative interdisciplinary co-design scenarios.

Compared to Group 1, Group 2 conducted their design process in a traditional collaborative manner, without the assistance of AIGC-Midjourney synergy. Their design concept focused on creating a massage chair equipped with an XY work platform and a machine vision system. This technology would enable the chair to intelligently recognize different body parts, aiming to alleviate the fatigue experienced by office personnel due to prolonged periods of sitting.

Group members gathered relevant design case studies to find design inspiration based on the design concept. Following an initial discussion, they each drew sketches based on their interpretations and then reconvened for a second round of discussion focused on these illustrations (Figure 11). As the mechanical background students were not able to effectively visualize the idea by sketch, the design background students redrew the mechanical students' sketches based on their face-to-face communication. The sketching solution was evaluated and selected in the third round of discussion. After modeling and rendering the final solution for approximately 4.5 h, the final solution was complete (Figure 12).

Figure 11. Interdisciplinary collaborative design scene based on the traditional model for the second group.

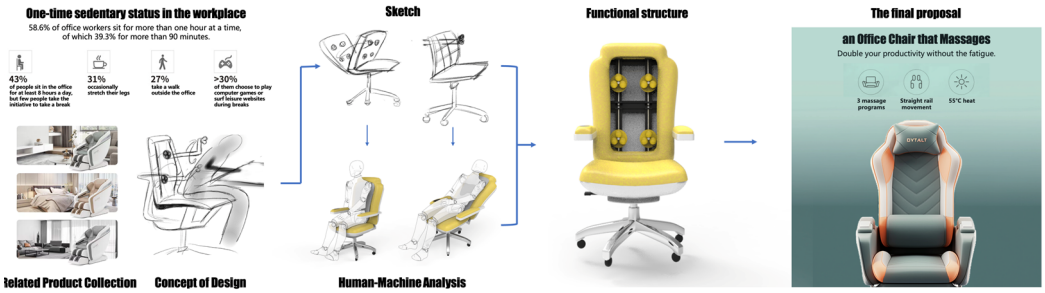

Figure 12. The second group of solutions is based on the traditional design process.

The data from the two groups in the interdisciplinary workshop are presented in Table 2. Over a comparable period, Group 1 (which utilized AIGC) underwent five times as many design iterations as Group 2, demonstrating that AIGC can significantly enhance design efficiency in interdisciplinary collaboration. To assess the quality of the designs, two external design experts were invited to evaluate the outcomes. Group 1 received scores of 85 and 88 out of 100, while Group 2 received scores of 78 and 80, showcasing the positive impact of AIGC on design quality. However, the evaluations from the external experts highlighted a shortcoming of AIGC in the aspect of design evaluation, which is a critical factor in the success of product design and demands a high level of expertise from designers.

Table 2. Impact of AIGC in interdisciplinary design collaboration.

Group	Program	Iteration Number	Design Quality Assessment	Overview of Interview Feedback
Group 1 (Apply AIGC + AMP Cards)	Burger Vending Machine	5	85/88	• AIGC facilitates interprofessional collaboration and communication. • AIGC can make up for a lack of sketching skills. • AIGC saves design time. • The design iteration process lacks auxiliary evaluation functions.
Group 2 (Without AIGC)	Office Scene Massage Chair	1	78/80	• Long time spent in the pre-program phase. • The visual effect of the program was not satisfactory due to time restrictions. • The mechanical background students had to rely on the design background students' hand-drawing skills to express design ideas clearly.

After the workshop, we interviewed members from both groups about their experiences of the workshop, as summarized in Table 2. An industrial design student from Group 1 expressed how AIGC improved their communication with mechanical engineering peers. They emphasized AIGC's ease of use for those, like them, lacking sketching skills, and appreciated its efficiency in the design process. Conversely, Group 2 students, not using AI tools, spent more time in discussions and felt their visual output was subpar. Those with a mechanical background felt their ideas were not expressed clearly until design-background students helped translate them. The feedback aligns with the table data, showing Midjourney's value in improving clarity and communication, especially for newcomers to the tool. Overall, integrating AIGC and AMP-Cards into interdisciplinary design workshops has augmented the advantages of quick, accurate, and visual communication, positively influencing multidisciplinary collaboration.

3. Discussion

The evolution of AIGC has catalyzed innovation and shifts in the design production model, also reshaping the skillset needed for future designers, who will need to acquire a new perspective. We have summarized the AIGC-based Midjourney Prompt Cards for Product Design (AMP-cards), which will help creators quickly learn how to use Midjourney to visualize and graphically present their ideas to assist designers in conducting design research and practice, as well as interdisciplinary collaboration with the iconic tool Midjourney. The introduction of Midjourney can reduce the learning and production time cost of modeling and rendering in the design process, as well as the skill limitations of novice designers caused by the learning of design tools, which inhibits their creativity and creates frustration in learning. In other words, design practitioners can "free their hands" from learning skills and concentrate more on developing creativity and innovation.

However, AIGC does not offer creators original design inspirations, so creators must discover their own. The technical principle of AIGC is to collect and learn from a large amount of text, images, and other multi-format data, combined with natural language processing, deep learning, and different algorithms, to automatically generate text content, images, and other creative design products, that is, through a large amount of existing data to optimize the algorithm for the automated generation of design content. In essence, these generated contents represent a fusion of existing solutions instead of original innovation. In most cases, as the design develops, the source of design inspiration has shifted from superficial motivation to in-depth study of a particular object, uncovering the mystery hidden beneath the surface to inspire design inspiration and apply it to a design project. For instance, in Case 1 in the article—Pearl Scallops Research—AIGC can accelerate the iterative process by rapidly generating program prototypes, freeing up much time and effort for pre-designing the research process. As a result, it is more likely to conduct leading-edge explorations with originality to realize the innovation of derivative concepts derived from the source, consisting of breakthrough and unique product solutions.

AIGC provides a powerful and extensive design material library that gives designers instantaneous access to inspiring images based on their requirements [34,35]. This also implies that designers should dedicate time to collaborate effectively with AIGC, giving the AIGC tool accurate and specific instructions. In utilizing the Midjourney tool for Case 2—Flying Car Styling Design, designers are required to conduct a systematic and comprehensive product styling analysis of the Cybertruck and sort out the textual descriptions of the design elements to the prompt. This suggests that future designers will need to deepen their comprehension of classic design cases, styles, and CMFs to effectively use the Midjourney tool for intentional solution generation.

Furthermore, AIGC also provides a co-creative platform for interdisciplinary collaborative co-design, lowering the barrier of entry for non-design professionals and allowing more people to collaborate on design innovation. The future of design will necessitate even greater interdisciplinarity. Designers, engineers, scientists, and sociologists collaborate to develop integrated design solutions that solve increasingly complex problems

and advance the design. This requires future designers to adapt to an interdisciplinary collaborative environment during their learning phase. The stumbling block in the process of multidisciplinary cooperation is that the knowledge gap between disciplines impedes the members' understanding of one another's ideas, and the abstract nature of the language expression itself is not friendly to the communication of ideas among the members. In Case 3—Interdisciplinary Design Workshop, students from diverse professional backgrounds apply the Midjourney tool to rapidly and visually express their design concepts. With AIGC, combined with AMP-Cards, as a rapid visualization tool, members from all fields can express their concepts accurately, bypassing the constraints of verbal communication. This greatly enhances the interdisciplinary collaborative process.

Currently, the selection of AI-generated solutions depends largely on designers' own experience, and there is still room for improvement in terms of market desirability, commercial value viability, and technical feasibility, and is primarily constrained by the following two technical limitations: (i) the lack of standardization in the generated results reduces the technical feasibility. For instance, AI can rapidly generate product structure in professional structural design (such as professional modeling software Creo's 3D generative design). However, the generated structure consists primarily of heterogeneous and complex parts that are difficult to process and suffer high production costs. (ii) AI training models are unidirectional and irreversible [36]. As design research must continually integrate new interdisciplinary knowledge, AIGC must also figure out how to make AI progress with designers and adapt to future design paradigm shifts.

Future developments in AI technology and computer mathematics will significantly impact optimizing design evaluation methods [37,38]. To enhance the evaluation capability of AI co-design through machine learning, user data are incorporated into the model training process, and design concept visualization and quantitative evaluation models for personalized and highly specialized fields are developed. After a round of generation, the model can provide quantitative evaluation data and optimization suggestions (such as the ten-level scoring system of the 'A' Design Award) based on the results in a timely and objective manner, promoting the collaboration between AIGC and content generators to control the quality of the results as a "referee" [39] and enhancing the efficacy of cross-disciplinary research. Employing emotional computing, personality computing, social computing, cultural computing, and other scientific and humanistic methods, one can study the human experience mode, expand the boundaries of human cognition, and lay the communication foundation for future interdisciplinary teams to carry out design and innovation cooperation as "lubricant" [40].

AIGC offers objective and comprehensive selection and judgment assistance functions for design collaboration, which will provide more accurate and targeted feedback information, allowing the generator to understand the design's results and flaws better and enhance the overall quality of the invention. It is foreseeable that the future in the field of innovation will likely actualize the closed loop of interdisciplinary "research design", achieving efficiency, precision, and stability [41].

In addition, it should be noted that ensuring the originality of the designer's concepts is important before leveraging the advantages of AI technology to enhance creative performance. AI should be used as a tool for enhancement and innovation rather than as a means of replication or replacement, thereby preserving the integrity, authenticity, and value of creative work.

4. Conclusions

In this paper, we delve into the integration of AIGC into design systems, using Midjourney as a representative AIGC tool to enhance collaboration and innovation among creators. We propose an AIGC-based Midjourney approach for product design, equipped with prompt formulas and the accompanying AMP-Cards, which intends to help content creators master Midjourney skills more rapidly. The role of AIGC, exemplified by Midjourney, is explored through its application in cutting-edge design innovations, corporate

projects, and interdisciplinary workshops. Specifically, AIGC co-design allows designers to focus more energy on researching design inspirations, particularly real-world inspirations, such as the design research of pearl scallops in Case 1. AIGC has an extraordinary advantage in design style mastery and rapid multi-program output, allowing for the rapid and iterative advancement of corporate-commissioned designs, particularly those concentrating on product styling style design. In cross-disciplinary teamwork, AIGC's robust database enables rapid visualization of design concepts, facilitating communication and accelerating solution iteration.

It is expected that the use of Midjourney in product design and its case practice, as outlined in this paper, will provide creators and teams with inspiration and reference for future design research and trial and interdisciplinary collaboration. Simultaneously, the case study exposes areas of improvement for the Midjourney tool, which can provide suggestions for future enhancements to the AIGC design tool.

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