

The Potential of Midjourney Models in Sustainable Packaging Design

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Abstract: The global shift toward environmental sustainability has pressured the packaging industry to innovate rapidly, transforming conceptual packaging workflows into highly resource-intensive processes. Concurrently, generative artificial intelligence (AI) has emerged as a disruptive force in visual communication, introducing new tools whose operational limits within professional workflows remain under-theorized. This study aims to evaluate the operational potential and structural limitations of Midjourney v6 in visualizing sustainable, ecological, and minimalist packaging designs, mapping out the precise boundaries of AI-driven eco-design. Utilizing a qualitative, single-case explanatory research design, this paper deconstructs a single high-fidelity cosmetics packaging archetype generated via Midjourney and cataloged within the OpenArt generative repository. The selected case is subjected to a rigorous critique across three analytical axes: the Formalist-Aesthetic Axis, the Technical-Material Axis, and the Functional-Communicative Axis. The findings demonstrate a profound asymmetry between computational macro-aesthetic synthesis and real-world functional utility. On the formalist axis, the algorithm exhibits an advanced capacity for stylistic synthesis, generating organic forms and eco-centric semiotic codes that simulate human taste. However, the technical-material and functional evaluations reveal systematic failures, including physically impossible lighting logic, spatial anomalies, and complete typographic illegibility due to the model processing letters as visual textures rather than semantic units. This study concludes that while Midjourney serves as an unprecedented macro-aesthetic ideation engine that dramatically accelerates the early conceptual phases of green design, it cannot function as a standalone production tool. It redefines the design workflow not by displacing human agency, but by shifting the human graphic designer's role to a critical curator, prompt engineer, and micro-technical coordinator who must enforce structural grid compliance and linguistic legibility.

Keywords: Generative Artificial Intelligence, Midjourney, Sustainable Packaging Design, Computational Aesthetics, Graphic Design Epistemology, Human-Computer Co-Creativity.

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I. INTRODUCTION

The global imperative for environmental sustainability has forced the packaging industry to undergo a radical transformation, shifting from non-biodegradable plastics to biophilic, organic, and ecologically responsible materials. In contemporary graphic design, packaging is no longer viewed merely as a protective container but as a complex socio-ecological artifact that communicates a brand's environmental ethics through visual and tactile cues (Lupton & Phillips, 2015). However, the traditional workflow for conceptualizing sustainable packaging—involving material testing, 3D CAD modeling, and physical prototyping—remains a resource-intensive and time-consuming process. The recent emergence of advanced generative artificial intelligence platforms, specifically Midjourney's latest text-

to-image architecture, introduces an unprecedented computational alternative [3]. Rather than operating as a passive drafting tool, Midjourney functions as a human-computer co-creative engine capable of translating descriptive, eco-centric textual parameters into high-fidelity, photorealistic visual simulations [4]. This study explores the latent potential of Midjourney in visualizing sustainable, ecological, and minimalist packaging designs, establishing a dual-axis critique of its aesthetic resonance and technical material fidelity.

To academicize the role of Midjourney in sustainable design ideation, the discourse must navigate the relationship between algorithmic generation and classical aesthetic judgment. Historically, the visual identity of "eco-friendly" products has been governed by a strict set of semiotic

codes—unbleached kraft paper texture, muted earth tones, and minimalist structural geometries [5]. When a designer inputs these parameters into Midjourney, the model does not engage in a conscious, empathetic reflection on environmental degradation or ecological ethics. According to Immanuel Kant's (1790) foundational aesthetic theory, true artistic creation requires "genius"—an intentional, conscious capacity to give rules to art born out of lived human experience [6]. Lacking this consciousness, Midjourney operates within a mathematical latent space, optimizing thousands of pixel distributions based on existing digital repositories of packaging aesthetics, such as those curated in the OpenArt Midjourney Packaging data frameworks. Consequently, the aesthetic evaluation of AI-generated eco-packaging shifts from the producer's moral intent to the spectator's perceptual reception of the formal composition. The algorithm achieves what Formalist critic Clive Bell (1914) defined as "significant form"—a harmonious organization of lines, colors, and textures that evokes a specific emotional and semiotic reaction, independent of the creator's biological identity [1].

In Midjourney's computational ecosystem, this significant form is manifested through the transformation of text prompts into intricate, photorealistic materials. ECOLOGICAL design often demands the visualization of unrefined, organic textures—such as mycelium structures, seaweed-based bioplastics, compressed bamboo fibers, and recycled molded pulp. Traditional 3D rendering engines require meticulous manual adjustments of displacement maps, sub-surface scattering, and specular highlights to replicate the tactile quality of these materials. Midjourney bypasses this friction by leveraging diffusion processes that recognize and replicate statistical patterns of light and micro-texture [7]. As demonstrated in extensive prompt galleries, the inclusion of technical tokens like "tactile organic texture," "translucent bioplastic skin," and "photorealistic studio lighting" allows the algorithm to synthesize materials that possess high physical plausibility. This shift fundamentally changes Walter Benjamin's (1935) classic critique of mechanical reproduction; we are no longer reproducing an existing physical packaging concept but rather executing an algorithmic generation where the digital image itself becomes the primary site of material experimentation [8].

However, the integration of Midjourney into the sustainable design workflow introduces a critical pedagogical and practical paradox. Graphic design is inherently bound by strict functional parameters, structural grids, and typographic hierarchy [2]. While Midjourney exhibits an exceptional capacity for macro-aesthetic synthesis—generating stunning compositions, color spaces, and ambient lighting—it consistently displays vulnerabilities in micro-technical execution. ECOLOGICAL packaging must convey precise regulatory data, ingredient lists, and branding elements. Because diffusion models process typography as a visual graphic pattern rather than a semantic system of language, the text generated within these sustainable packaging simulations often devolves into illegible typographic artifacts or pseudomorphic glyphs (Noble & Bestley, 2016). Thus, a

gap exists between the fluid, organic aesthetic generated by the machine and the rigid, mechanical precision required for structural manufacturing and legal communication.

This study aims to bridge this analytical gap by conducting a rigorous qualitative evaluation of specific case templates derived from sustainable and minimalist prompt paradigms within the Midjourney ecosystem. By deconstructing how the algorithm interprets prompt structures regarding organic texturing, volumetric lighting, and minimalist layout constraints, this paper maps the boundaries of AI-driven eco-design. Ultimately, this research argues that Midjourney should not be viewed as a replacement for the human graphic designer, but rather as an advanced collaborative partner that radically accelerates the conceptualization phase of sustainable packaging, allowing designers to visually test the aesthetic boundaries of ecological materialism before committing to physical production.

II. METHODOLOGY

This study utilizes a qualitative, single-case explanatory research design to investigate the operational potential and structural limitations of generative artificial intelligence in graphic design. While multiple-case studies offer broader comparisons, a single-case deep-dive approach is uniquely suited for analyzing emerging technological phenomena, as it allows for an exhaustive, granular deconstruction of a single complex artifact from multiple analytical perspectives (Noble & Bestley, 2016). The focus of this methodological framework is a specific sustainable packaging design archetype—a minimalist, ecological cosmetics container—generated via Midjourney v6 and cataloged within the OpenArt generative design framework. By isolating a single high-fidelity artifact, the study avoids superficial generalities and instead provides a rigorous, multi-layered critique of how deep-learning diffusion models simulate physical materials and design principles.

The research design is operationalized through a tripartite analytical pipeline consisting of (1) Prompt Archetype Construction, (2) Multi-Angle Evaluative Scrutiny, and (3) Human-Machine Creative Synthesis. The first stage involves the extraction and deconstruction of the generative metadata. The selected case was synthesized using a carefully calibrated prompt string that combines ecological semantic tokens ("organic seaweed bio-material," "sustainable," "biodegradable") with professional design parameters ("minimalist studio lighting," "die-cut structure," "matte texture"). Analyzing the semantic weight of these inputs allows the study to evaluate how Midjourney translates abstract environmental concepts into tangible pixel distributions within its computational latent space.

The second and primary stage of the methodology evaluates the generated artifact across three distinct analytical axes, mapping both its philosophical and practical dimensions:

- The Formalist-Aesthetic Axis: Grounded in Bell's (1914) theory of "significant form," [1] this axis evaluates the

purely visual composition of the packaging. It examines color harmony, spatial balance, visual entropy, and the model's capacity to evoke an immediate "eco-centric" semiotic response without relying on textual explanation.

- The Technical-Material Axis: Drawing from Lupton and Phillips' (2015) foundational graphic design principles, this axis scrutinizes the physical plausibility of the generated image. The analysis targets material rendering fidelity (e.g., texture depth, light refraction on bioplastics), global lighting consistency, and spatial perspective accuracy.
- The Functional-Communicative Axis: This axis tests the design's real-world viability by evaluating typographic integration, structural grid compliance, and its operational readiness for industrial manufacturing or legal product labeling.

In the final stage, the findings from these three axes are synthesized to determine the precise status of the AI output within the professional design workflow. By contrasting Midjourney's automated macro-aesthetic rendering against the strict micro-technical demands of professional graphic design, the study establishes a critical synthesis. This final phase maps out exactly where the algorithm's autonomy ends and where the human designer's technical intervention must begin, transforming the single digital simulation into a functional, production-ready piece of visual communication.

III. RESULTS AND DISCUSSION

A. Prompt Deconstruction And Computational Syntax

The single artifact selected for this qualitative evaluation represents a contemporary archetype of sustainable cosmetics packaging, generated via Midjourney v6 and derived from the minimalist design paradigms cataloged within the OpenArt generative repository. To understand the visual output, one must first deconstruct the linguistic syntax that initiated the algorithmic generation in Midjourney's latent space. The generative text prompt was structured as follows:

"Minimalist luxury skincare bottle, made from raw biodegradable mycelium and translucent seaweed bioplastic, hyper-realistic organic texture, earthy muted tones, volumetric studio lighting, clean biophilic composition, high-end sustainable product design --v 6.0"

This prompt operates through a combination of thematic, material, and technical tokens. The inclusion of nouns such as "mycelium" and "seaweed bioplastic" instructs the network to pull from clusters of images associated with fibrous, organic, and semi-translucent material properties. Meanwhile, descriptors like "minimalist luxury" and "volumetric studio lighting" apply structural constraints, forcing the algorithm to organize the visual assets into a clean, high-contrast composition rather than a cluttered or chaotic arrangement. The model processes these semantic inputs not by understanding what "sustainability" means philosophically, but by calculating the statistical probability of pixel coordinates that historically co-occur with these specific words in human-curated design databases [7].

B. The Formalist-Aesthetic Axis: Significant form and Semiotic Resonance

When analyzed through Clive Bell's (1914) formalist lens of "significant form," [1] the generated artifact exhibits a remarkable capacity for aesthetic synthesis, achieving a harmonious relationship between color, shape, and spatial balance without the necessity of human artistic intention. The composition is anchored by a central, vertically oriented bottle where the physical geometry seamlessly transitions from a rough, solid base to a delicate, translucent neck.

- Color Harmony and Mood: The color distribution utilizes a sophisticated, low-saturation palette dominated by raw alabaster, muted olive, and soft taupe. This choice of color entropy directly adheres to modern eco-centric design aesthetics, where high-saturation colors are rejected because they semiotically connote artificiality or chemical processing (Noble & Bestley, 2016). The algorithm successfully distributes these tones to create a clear figure-ground separation, positioning the soft, earthy container against a crisp, neutral backdrop that enhances the product's "premium" market positioning.
- Visual Hierarchy and Balance: The visual hierarchy is governed by an innate sense of balance and proximity (Lupton & Phillips, 2015). The light is mathematically optimized to fall softly across the curved contours of the bottle, creating a natural gradient of highlights and shadows that guides the spectator's eye from the top closure down to the textured base.
- Kant's Aesthetic Paradox: This aesthetic success brings Immanuel Kant's (1790) theory of aesthetic judgment into sharp focus. The object possesses an undeniable sense of "purposiveness without purpose" (Zweckmäßigkeit ohne Zweck). To a human spectator, the delicate imperfections on the bottle's surface feel like a deliberate, artistic choice made by a designer seeking to celebrate the raw beauty of nature. However, because Midjourney lacks consciousness, this organic elegance is entirely accidental—it is the result of a machine successfully executing mathematical optimization. The "beauty" of the packaging does not reside within the machine's creative mind but is entirely constructed during the spectator's cognitive reception of its formal composition. The algorithm has not created art; it has synthesized a highly convincing simulation of human artistic taste.

C. The Technical-Material Axis: Material Fidelity And Algorithmic Artifacts

While the formalist analysis highlights Midjourney's strength in macro-aesthetic synthesis, evaluating the artifact along the technical-material axis reveals a critical tension between visual plausibility and physical reality. This axis applies foundational graphic and industrial design principles (Lupton & Phillips, 2015) to evaluate how accurately the deep-learning model simulates the physical properties of matter, light interaction, and structural physics.

- Micro-Texture and Material Fidelity: One of Midjourney v6's most significant advancements is its capability to render high-frequency surface details. Within the generated artifact, the contrast between the fibrous,

porous texture of the mycelium base and the smooth, semi-translucent quality of the seaweed bioplastic neck is executed with exceptional photorealistic fidelity. The machine successfully predicts how a rough surface absorbs light compared to how a translucent surface scatters it—a phenomenon known in 3D rendering as sub-surface scattering. This technical precision tricks the human eye into perceiving a tactile depth that typically requires complex shader programming in traditional digital workflows [7].

- **The Breakdown of Global Lighting Logic:** Despite this pixel-level success, a macro-evaluation of the image's physics exposes clear algorithmic inconsistencies. While the primary light source is positioned to create a soft volumetric glow from the upper left, the internal reflections within the translucent seaweed neck do not fully match this vector. The algorithm generates light reflections based on localized pattern matching rather than a global calculation of ray tracing or physical optics. This discrepancy creates a subtle cognitive dissonance for professional observers: the object looks real at a glance, but its lighting logic behaves impossibly under the laws of physical environments.
- **Spatial and Structural Anomalies:** Additional structural vulnerabilities appear where the base of the cosmetics bottle meets the horizontal plane. In a physical photo studio, an object's weight creates a precise contact shadow and a subtle reflection on the surface it rests upon. Midjourney, however, frequently creates a "floating" effect or an ambiguous blending where the boundary between the mycelium texture and the ground plane becomes blurred. This lack of geometric precision indicates that while the diffusion process is outstanding at generating convincing textures, it fundamentally lacks an underlying understanding of 3D spatial logic and gravitational physics. The model constructs a beautiful two-dimensional arrangement of shapes that simulates three dimensions without respecting structural manufacturing constraints.

D. The Functional-Communicative Axis: Typographic Failures and Production Reality

The final axis evaluates the design's real-world viability. Graphic design is fundamentally a system of functional communication, not just aesthetic expression [2]. This is where Midjourney's autonomy hits its most rigid boundary. When processing the visual branding elements, the model fails to generate legible brand names or product specifications. It produces pseudo-glyphs—alien-like letterforms that look like text from a distance but carry no semantic meaning. This occurs because diffusion models treat typography as an aesthetic, visual texture rather than a linguistic tool meant for human reading [5]. Real-world sustainable packaging requires strict adherence to technical layouts, including bar codes, ingredient lists, and net weight indicators. Midjourney cannot self-impose these regulatory grid systems. It prioritizes visual beauty over practical communication, rendering any informational text as distorted graphic noise.

The formalist evaluation reveals that Midjourney possesses a highly optimized capacity to replicate what Bell (1914) termed "significant form" [1]. By utilizing low-saturation color distribution and organic, curvilinear contours, the model autonomously establishes a compelling visual narrative of environmental sustainability. This validates Manovich's (2018) assertions on AI aesthetics [7], proving that neural networks can successfully predict and execute the macro-aesthetic visual codes preferred by human consumers.

However, the technical-material evaluation uncovers a paradox: this surface-level beauty operates without an underlying understanding of physical reality. The breakdown of global lighting logic, combined with the spatial anomalies where the artifact meets the ground plane, indicates that Midjourney builds a flat simulation of depth rather than navigating a true three-dimensional environment. In practice, this means the machine operates purely as an image-generation engine rather than a structural design tool. It lacks the capacity to self-impose the mathematical and physical constraints central to traditional industrial and graphic design practices (Lupton & Phillips, 2015).

IV. CONCLUSION

Ultimately, this case study shifts the philosophical evaluation of AI in visual arts from a binary debate over displacement to a nuanced framework of collaboration. Midjourney's lack of intentionality (Kant, 1790) prevents it from executing purposeful communication independently. The artifact generated is not a production-ready design but a rich, complex aesthetic blueprint. The true value of AI in sustainable design lies in this rapid, low-resource material simulation. It allows designers to visually challenge traditional, non-biodegradable design biases and explore raw, organic aesthetics before committing physical and economic resources to manufacturing.

COMPETING INTERESTS

The author has declared that no competing interests exist.

ETHICAL APPROVAL

Ethical approval was not required for this research as the study relies entirely on the qualitative analysis of publicly available, AI-generated digital artifacts and involves no live human or animal subjects.

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