TEXT-BASED SKETCHING PROCESS: ARTIFICIAL INTELLIGENCE-SUPPORTED ARCHITECTURAL DESIGN

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Abstract
Sketching is considered one of the fundamental components of the design process, enabling designers to materialize, visualize, and effectively communicate their ideas. These rapid and practical drawings, frequently employed in various phases of design, contribute to the process of visual thinking, supporting creativity and facilitating the clear, consistent, and comprehensible expression of design concepts. Throughout history, architectural requirements and techniques have undergone continuous transformation, with innovative methods being developed to adapt to changing conditions. Particularly with the widespread adoption of computer-aided design tools, the use of virtual drawing environments has gained prominence, leading to profound changes in architectural design processes. Today, this transformation has gained a new dimension through artificial intelligence-based design applications, providing remarkable contributions to promoting architectural innovation and enhancing efficiency within design processes.
In this context, the present article examines the impact of AI-assisted sketches on designers' creativity and productivity capacities, addressing the functions of these technologies across different stages of the design process and their contributions to creative thinking from an interdisciplinary perspective.
Keywords: Architectural design, sketching, artificial intelligence, creativity

INTRODUCTION

Design is a complex discipline grounded in imagination and defined in the literature as a process of "creative problem-solving." Ill-defined or under-defined problems are regarded as design problems; by their very nature, they lack explicit solutions and involve unique, subjective conditions. Therefore, design processes consist of complex stages, requiring designers to approach problems from multiple perspectives and to possess creative thinking skills. At this point, creativity emerges as an indispensable element within the design discipline.
Sketches are characterized by lines that embody uncertainty and flexibility; these qualities allow designers to explore alternative solutions and generate new ideas. These rapid drawings, which reflect the designer's personal style and creative thinking, outline the main framework of the design, thereby accelerating the transition to the detailing phase. The flexibility provided by sketches not only enables experimentation and discovery in the early stages of design but also ensures direction and focus throughout the process. Furthermore, sketches serve as an effective tool for communication and collaboration among designers, facilitating the sharing of ideas and feedback while supporting design as a collective process.
In architectural design, creativity is directly linked to problem-solving and enables designers to perceive new spatial forms, discover original relationships, and generate innovative ideas. Visual thinking is a critical skill for creativity in architectural design processes, as it assists designers in rapidly materializing spatial concepts. Historically, sketching has been the fundamental tool of architectural design, offering the most practical way of expressing ideas quickly and originally. The sketching phase is considered an indispensable starting point in design, a process in which designers begin to materialize and develop raw ideas. As İnceoğlu emphasizes, sketching can be regarded as a visual "murmur" of mental processes, making it an ideal tool for shaping thoughts at the outset of the design process (Balamir, 2020).
According to Ayıran (2007), sketching enables designers to perform creative leaps by continuously stimulating cognitive processes and fostering the emergence of innovative and original design ideas. Through overlapping drawings that create ambiguous visual representations, sketches keep memory in a state of constant activation, preserving cognitive dynamism. Moreover, each new sketch reveals forms absent in the previous one, thereby supporting divergent thinking—one of the fundamental indicators of creativity.
Traditional hand-drawn sketches play a crucial role in exploring and developing ideas in the early stages of the design process. Conventional techniques typically consist of two-dimensional drawings on paper, three-dimensional perspectives, and physical models, while digital technologies extend this variety by offering a broader range of representational tools (Yıldırım, Yavuz, & İnan, 2010).
With technological advancements, digital design tools have become increasingly widespread in architectural processes. Digital environments provide designers with tools that foster creativity, speed, and efficiency; however, they may also impose creative limitations, such as leading to homogenization in design outcomes.

Artificial intelligence (AI) has emerged not only as a technological innovation but also as a dynamic field of research transforming interdisciplinary interactions. Ongoing advancements have enabled the redefinition of design methods in architecture, particularly by paving the way for qualitative changes in conceptual production, representational modes, and decision-making processes. Initially focused on mimicking human thought and learning processes, AI has now been integrated into the creative stages of architectural design, accelerating and enriching the transformation of abstract ideas into tangible forms. The interaction between sketching and AI signals a significant transformation in design practices. Traditionally, sketches have served as tools for externalizing human creativity at the onset of design; AI enhances this process by analyzing sketches and generating alternative interpretations. By drawing on large databases, AI can produce a variety of design alternatives, enabling designers to evaluate and refine their ideas rapidly. Consequently, the design process becomes more efficient and dynamic, while the diversity of creative possibilities expands.

This study aims to present proposals on the use of AI during the sketching phase, exploring how AI-assisted programs enhance efficiency, accelerate workflows, and support designers in producing more qualified and original outcomes. In addition, the study evaluates the advantages these technologies offer compared to traditional sketching approaches, as well as their potential to stimulate creative thinking and contribute to architectural design processes.

1. A THEORETICAL EVALUATION OF THE WORKING PRINCIPLES OF HUMAN AND ARTIFICIAL INTELLIGENCE

Artificial intelligence (AI) research emerged as a discipline that seeks to analyze the mechanisms of the human mind and to develop systems capable of imitating cognitive functions such as thinking, learning, reasoning, and decision-making. The theoretical foundations of this field trace back to the 1950s, particularly to Alan Turing's famous question: *"Can machines think?"* Turing's inquiry not only pioneered the conceptualization of artificial intelligence but also laid the groundwork for intense academic debates concerning the boundaries and possibilities of machine intelligence. One of the central issues discussed at the time was whether machines could exhibit cognitive processes comparable to those of the human mind.

The Dartmouth Conference of 1956 is regarded as one of the most critical milestones in the early stages of AI research. During this conference, John McCarthy introduced the term *artificial intelligence* into the literature, defining the discipline as "scientific and engineering efforts directed toward the development of intelligent computer programs." This definition not only outlined the conceptual framework of AI but also served as a paradigm guiding both theoretical approaches and applied research in the field.

AI research fundamentally aims to analyze human cognitive processes and decision-making mechanisms, reproducing them through computational models. Algorithms developed in this context emulate the information-processing methods of the human brain, enabling machines to acquire capabilities such as learning, inference, planning, natural language comprehension, and visual perception. Consequently, AI has positioned itself at the intersection of cognitive science and computer engineering, becoming an inherently interdisciplinary research domain.

The underlying principle of AI systems lies in their design based on the functioning and cognitive structure of the human brain. For this reason, brain functions and behaviors are reduced to algorithms and modeled computationally. Complex abilities such as problem-solving, learning, and decision-making are thus expressed through algorithms, making them executable by computers. For instance, through learning algorithms, AI systems can utilize experience to improve their knowledge and adapt to new situations. In this sense, as long as a process can be reduced to an algorithm, AI is capable of executing it (Özaktaş, 1998).

Human intelligence, by contrast, encompasses the capacity to design through the interaction of past experiences, emotional processes, and imaginative thinking. These elements introduce dimensions of originality, creativity, and innovation into the design process. Humans analyze existing conditions, identify problems, devise strategies, and implement solutions in ways that integrate aesthetics with functionality. Emotional orientations, personal experiences, and cultural backgrounds incorporated into design practices contribute to human-centered outcomes that are responsive to user needs. Therefore, the human designer is not limited to producing merely technical and functional solutions but is also capable of creating designs of high aesthetic value that evoke emotional engagement.

AI systems, on the other hand, stand out with their ability to process large volumes of data in a short period of time and to derive meaningful outcomes from them. Through algorithmic processes, they can generate diverse design alternatives within predetermined rules and constraints. Employing advanced data processing techniques, machine learning, and deep learning approaches, AI can analyze large datasets, identify recurring patterns, make predictions based on past experiences, and propose innovative design alternatives derived from available information. In this respect, AI serves as a strategic tool particularly in solving multidimensional problems and in processes that demand rapid generation of design drafts.

2.THE ROLE OF ARTIFICIAL INTELLIGENCE IN SKETCH PRACTICE

In architecture and design disciplines, sketching occupies an indispensable role in translating abstract ideas from a conceptual level into spatial and visual representations. Sketches, which function primarily in the early stages of design, not only facilitate the visualization of cognitive processes but also promote the development of creative thinking, the emergence of conceptual diversity, and the exploration of alternative solutions. From the designer's perspective, sketching is a productive method that allows ideas to be expressed rapidly, directly, and experimentally. These drawing-oriented practices facilitate the transfer of abstract conceptual structures onto visual planes and establish a conceptual foundation that can later be elaborated in the design process.

Traditional sketching techniques enable designers to quickly and effectively transfer mental images onto paper. These methods support spontaneous creative processes and allow ideas in the designer's mind to be directly externalized. In this regard, sketching functions not merely as a technical drawing tool but also as a critical means of exploring thought and developing alternative conceptual approaches. Particularly in the early stages of design, sketches play an essential role in problem identification, investigation of potential solutions, and the generation of innovative ideas. Thus, the importance of sketches in architectural and design processes derives not only from their role as a visual design tool but also from their capacity to externalize cognitive processes and foster creative problem-solving.

The integration of advanced technologies, such as artificial intelligence (AI), into design processes has led to a significant transformation in the role and usage of traditional sketches. AI, developed to understand, model, and simulate human cognitive processes, offers new possibilities within architecture and design disciplines. In this context, the interaction between AI and sketches not only digitizes traditional drawing techniques but also introduces new dimensions and functionalities into the design process.

The interaction of sketches with AI represents a profound transformation in design practices. This approach allows designers to convey their thoughts and conceptual visions rapidly and freely, holding critical importance for the direct externalization of creativity. AI's engagement with this process adds a new dimension to design, enabling practices that extend beyond traditional approaches.

By analyzing sketches, AI can generate various design options and alternative solutions by leveraging extensive databases. This capability allows designers to evaluate, refine, and enhance their creative ideas more quickly. Consequently, the design process becomes not only more efficient but also enriched by expanding creative perspectives. AI's comprehensive virtual trial-and-error capacity overcomes limitations encountered in traditional design processes, offering designers a broad spectrum of possibilities. This synergy allows designers to combine their natural creativity with the computational power and analytical capabilities provided by AI, thereby producing more comprehensive and innovative solutions.

Trial-and-error is an integral component of the design process, involving the generation of alternative solutions, evaluation of their effectiveness, and selection of the most appropriate option. AI expands this process by enabling the evaluation of numerous possibilities within a shorter timeframe through data-driven analysis. This capability enhances the efficiency of the design process and allows designers to explore a greater number of alternatives. The convergence of sketching and AI introduces a dynamic structure into the design process while significantly expanding creative potential. When AI's rapid analysis and recommendation capabilities are combined with the spontaneous and creative nature of sketches, stronger and more effective design processes emerge.

The integration of AI into design practices redefines the traditional creative and exploratory functions of sketches. By analyzing large datasets, recognizing patterns, and proposing probabilistic design solutions, AI supports designers' conceptual processes. As a result, sketching has evolved from being traditionally a singular creative expression tool to a multifaceted design platform enriched with AI-generated suggestions and alternatives.

This new generation of AI-assisted design processes not only enables the creation of sketches in digital environments but also allows dynamic and interactive contributions to designers' cognitive processes. Consequently, the interaction between AI and sketches has become an increasingly significant topic of research in architecture and design.

3.THE USE OF ARTIFICIAL INTELLIGENCE IN ARCHITECTURE

Artificial intelligence (AI) is the process of modeling cognitive abilities such as reasoning, inference, generalization, and learning from past experiences, and imparting these capabilities to computers or machines (Yılmaz, 2019). Today, the influence of this concept has expanded into nearly every discipline, professional field, and daily practice, and it interacts with architecture, a discipline where artistic and technological elements converge (Yıldız, 2014). The interaction between AI and architecture is considered an inevitable development, given the opportunities technology provides to the architectural field. The technical advantages offered by AI are driving significant transformations in various processes within the discipline of architecture. Currently, AI is effectively employed in functions such as optimizing fixture layouts in floor plans, collecting data about physical space users through sensor technologies, rapidly generating as-built surveys of spaces, and producing spatial outputs in different design styles. These advancements enhance both the speed and the accuracy and flexibility of architectural design processes.

The increasing adoption of AI technologies in architecture has led to various projections regarding the future of this relationship. These projections sometimes reflect a utopian vision of the future and, at other times, a dystopian perspective. At the core of these discussions lies the question of whether, in the future, an algorithm can think like an architect and produce an original design while considering all design parameters. Although the extent to which human-developed algorithms will be effective in the architectural design process remains uncertain, the fact that AI will bring profound changes to architectural production cannot be overlooked (Öztürk, 2018).

The potential of AI in architectural practice should be examined in the context of deepening interdisciplinary interactions and the integration of technological advancements into architectural production processes. AI's capabilities in data analysis and simulation enable innovative solutions previously unattainable in design processes. Analyses conducted on large datasets, in particular, provide in-depth insights into user behaviors and spatial dynamics. Design decisions informed by these data allow architects to develop more conscious and user-centered projects. Furthermore, AI-assisted design tools facilitate the rapid simulation of alternative design scenarios, enabling architects to evaluate various solutions and optimize the selection of the most suitable option.

4. DEVELOPING DESIGN THROUGH TEXTUAL DATA

The generation of visual outputs from textual data has become one of the most prominent research topics in the field of artificial intelligence in recent years. Souza et al. (2020) define this process as the production of digital images based on textual descriptions. This approach is considered not merely a technical transformation but also a methodological innovation, enabling a rethinking of the relationship between language and visuality in design practice.

The development of deep generative models has significantly enhanced the functionality of text-to-image systems. Crowson et al. (2022) and Rombach et al. (2022) emphasize that these systems are widely used in shaping architectural designs, diversifying artistic outputs, and generating digital content. Consequently, the design process, mediated through textual inputs, evolves beyond a mere drawing practice, becoming a production and exploratory tool applicable across various domains.

With the increasing accessibility of such systems through online platforms, these tools have attracted broad user engagement. Models capable of processing natural language inputs (prompts) enable users to obtain high-quality visual outputs by providing only conceptual descriptions. Oppenlaender (2022) notes that these technologies can analyze textual descriptions of a scene, object, or space and generate consistent digital visuals with high aesthetic value that correspond to these descriptions.

In summary, the approach of developing design through textual data is considered not only a technical innovation but also a conceptual transformation in architecture and design disciplines. This method allows designers to translate abstract ideas into visual forms, experimentally test different scenarios, and systematically expand creative diversity. Moreover, these generative systems go beyond mere visualization tools, restructuring the design process, diversifying aesthetic approaches, and contributing new dimensions to methodological research.

4.1. LEONARDO AI AND SKETCH GENERATION FROM TEXTUAL DATA

AI-based technologies in design are evaluated not only as tools for accelerating production but also as innovative approaches providing a methodological framework to support creativity. Within this scope, Leonardo AI is an AI application capable of interpreting user-defined design parameters and generating new architectural-scale proposals. The system is built on a Generative Adversarial Network (GAN) infrastructure, enabling the automatic production of diverse formal and spatial solutions according to specified criteria.

One of Leonardo AI's most notable features is its ability to generate sketches in the early stages of the design process. This capability provides designers not only with rapid visual outputs but also facilitates the quick testing of multiple design scenarios, enhances conceptual diversity, and systematically guides the creative process. From this perspective, Leonardo AI repositions sketching not merely as a visualization technique but as a conceptual laboratory enriching design research.

Launched in 2019, Leonardo AI serves as a digital production tool for designers in the early stages of their work. The system offers an intuitive interaction environment, enabling the rapid generation of conceptual sketches at the outset of projects. The application is not limited to two-dimensional sketches; it also produces three-dimensional visual representations, offering alternatives across different scales. In this respect, Leonardo AI is considered an experimental platform that supports cognitive diversity in the early stages of architectural design and expands the conceptual framework of design.

Figure 1. Street Sketch Produced by Leonardo AI (Yeşil, 2024)

The process of creating sketch images using Leonardo AI begins with the user defining a specific design concept or problem. Initially, users access the system interface and create a new project through a user-friendly screen. During project creation, users provide a prompt specifying the design objective. Once the prompt is entered, users must determine critical parameters to be considered during the design process. Leonardo AI analyzes this information to generate appropriate design suggestions.

After specifying the required design criteria, the system automatically generates architectural sketches and 3D visualizations. The produced sketches are presented within seconds, allowing users to review and identify elements to be refined or selected. Providing feedback helps Leonardo AI achieve more accurate results in subsequent design iterations. Users can customize sketches by selecting particular design elements or adding new inputs. Finally, the sketches chosen and developed by users become visual materials suitable for later stages of the project. These outputs contribute to the more effective processing of conceptual ideas and the realization of projects within the architectural design process. Thus, Leonardo AI is evaluated not only as a technical support tool but also as an innovative approach that diversifies the creative aspect of design and restructures production processes.

4.2.DALL-E AI AND SKETCH GENERATION FROM TEXTUAL DATA

DALL-E is an artificial intelligence model developed by OpenAI, capable of generating original and creative visual content by leveraging interactions between images and text. Introduced in 2021, this innovative model produces realistic and aesthetically appealing visual outputs based on a text-based input (prompt). DALL-E is designed as an integrated combination of a large-scale language model and various image processing techniques, enabling the generation of visual content in alignment with textual prompts provided by users.

In architectural practice, DALL-E is regarded as an innovative AI tool that allows for the generation of visuals from textual inputs. The model processes descriptive prompts provided by the user to produce multiple sketches and visual variations. When a designer defines a specific conceptual approach or spatial idea through detailed textual descriptions, the system interprets these inputs to create visualized drafts. This functionality facilitates rapid testing of alternative scenarios during early stages of the design process, enhancing creative diversity (Yeşil, 2024).

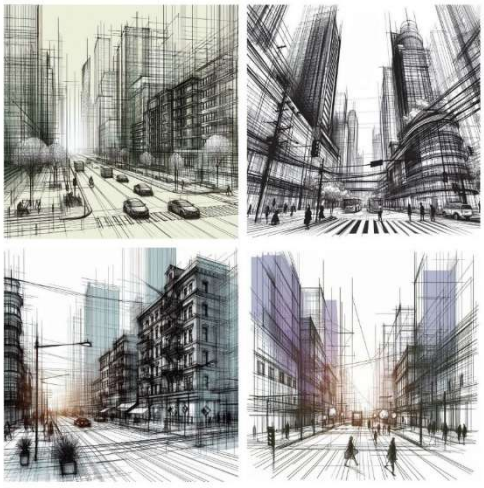

Figure 2. Street Sketch Generated by DALL-E AI (Yeşil, 2024)

The sketch generation process using DALL-E is interactive and user-friendly, aiming to streamline architectural design workflows. The process begins with logging into the platform and initiating a new project. Subsequently, a

text-based prompt must be created for DALL-E to generate sketches. The prompt should clearly and comprehensively define the characteristics of the intended visual output. Once submitted, DALL-E produces multiple sketches and images aligned with the provided description within a short timeframe. Users can review the outputs and, if necessary, refine the prompt to generate revised results. The finalized visuals can be saved for use in projects, enabling architects and designers to rapidly transform conceptual ideas into visual representations, thereby accelerating and enriching the design process with greater flexibility and innovation.

4.3.MIDJOURNEY AND SKETCH GENERATION FROM TEXTUAL DATA

Since the 2010s, text-to-image generation models have undergone significant development (Dhariwal & Nichol, 2021; Saharia et al., 2022). The impact of AI on artistic production has accelerated over the past decade, paving the way for innovative applications. The sale of Edmond de Belamy's portrait at auction in 2018 marked a critical milestone in the widespread recognition of AI-generated artworks. During this period, systems capable of generating visual content from natural language inputs experienced notable evolution (Lyu et al., 2022). These systems operate through deep neural networks trained on extensive visual and textual datasets (Saharia et al., 2022). Currently, AI-assisted text-to-image generation technologies are widely accessible not only in academic and professional contexts but also to general users via popular platforms such as MidJourney.

MidJourney-AI was developed in 2022 by a technology startup based in San Francisco and operates through a Discord®-based platform, emphasizing user interaction (Salkowitz, 2022). This AI-based system distinguishes itself from traditional design tools by positioning itself within a social communication environment. The Discord® infrastructure enhances accessibility and allows users to participate collaboratively in visual generation processes through textual prompts. Thus, MidJourney-AI not only represents a technological innovation but also serves as an online platform offering collective experiences in design and visual production practices.

Figure 3. Street Sketch Generated by MidJourney AI (Yeşil, 2024)

MidJourney is increasingly regarded as a key tool in the evolution of digital sketching practices within architecture. Particularly during conceptual design phases, it facilitates the translation of abstract ideas into visual representations, providing designers with a platform to diversify their creative processes. Operating through text-based inputs, the system enables users to specify aesthetic preferences and functional requirements, generating sketches that support the creation of different spatial scenarios during early project stages. Consequently, the design process is not only accelerated but also rendered more suitable for the comparative evaluation of alternative solutions. MidJourney's functionality allows rapid visualization of ideas while enabling designers to explore various approaches and develop new conceptual perspectives.

5. CONCLUSION

Architectural design is a complex and multifaceted process in which abstract ideas are transformed into tangible forms. Within this process, concepts that have not yet been fully formed in the designer's mind emerge with a desire to acquire rapid and concrete expression. The initial manifestation of these thoughts typically occurs through sketches. Sketches serve as a fundamental tool that enables designers to quickly and flexibly express ideas, possibilities, and potential solutions. In the early stages of the design process, the uncertainty, flexibility, and simplicity offered by sketches allow the creative process to progress in a dynamic and fluid manner. Consequently, sketches play a critical role in helping designers clarify ambiguous or insufficiently defined design problems. Additionally, sketches provide designers with the opportunity to free their thoughts, generate new ideas, and reevaluate existing concepts, thereby deepening the creative process.

In the design process, sketches are not merely a means of expression but also function as practical tools that reduce cognitive load and promote creative thinking. As designers transfer their mental ideas onto paper through sketches,

they engage both long-term and short-term memory effectively, strengthening the interaction between these two memory types. In this context, sketches allow designers to express their creative thought processes continuously and fluidly. Moreover, the development of sketches independently from detailed aspects in the early design phases supports the production of more innovative and original solutions. Considering that excessive focus on details can constrain creativity, sketches provide a platform for ideas to emerge beyond such limitations.

The rapid advancement of technology has led to profound transformations in art and design, with artificial intelligence (AI) technologies offering revolutionary innovations in these fields. AI enables artists and designers to accelerate creative processes, allowing for more effective, efficient, and productive work. As a tool supporting creative processes, AI enhances the cognitive and expressive capabilities of designers and artists. In architectural design, AI-assisted sketching allows designers to develop their ideas more quickly and in greater detail. The contributions provided by AI in this context facilitate the generation and refinement of sketches, making the design process more flexible, rapid, and creative.

In conclusion, AI-assisted sketching tools offer an innovative approach to architectural design processes. These technologies, with their potential to accelerate and enhance creative thinking, allow designers to rapidly materialize their ideas and generate alternative solutions. The flexibility and efficiency provided by AI models encourage designers to think more freely and creatively, while also saving time and resources. In this respect, the development of AI-based sketching systems introduces a new dimension to creative thought in architecture, and it is anticipated that these technologies will be employed in increasingly sophisticated and comprehensive ways in the future.

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