Drawing, Scripting, Prompting. A Critical Approach from Architectural Graphics

Ángel J. Fernández-Álvarez, Vicente López-Chao

Abstract

In recent years, architecture has undergone a significant transformation with the introduction of digital tools and techniques. Three prominent techniques in this context are drawing, scripting, and prompting, offering architects novel approaches to the design process. Drawing remains a vital tool for idea exploration and design development. Conversely, scripting and prompting are digital methods that enable a more algorithmic and data-driven design approach. This paper explores the intersection of these techniques and their potential to enhance the design process. By using them together, architects can foster creativity, efficiency, and innovation while allowing more time for conceptual development. The paper analyzes the framework posed by these techniques, including the impact of new digital technologies like generative and algorithmic design, and artificial intelligence. The potential of scripting to automate graphic tasks, such as parametric design and generative drawing, is addressed. Furthermore, the paper delves into the new frontier of prompting and its application in architectural graphics, outlining the competencies architects need to effectively utilize this technology. In conclusion, this paper critically evaluates the current state of architectural graphics, exploring the fusion of traditional and digital methods, and how new technologies can transform the design process.

Keywords: architectural graphics, Artificial Intelligence, design process, digital thinking, parametric design.

Introduction

During the first two decades of the XXI century, the field of architecture has experience a significant transformation with the introduction of digital tools and techniques [Dunn 2012]. Coined as the 'digital turn' [Carpo 2017], this period highlighted three techniques –drawing, parametricism, and novel AI-based tools (Artificial Intelligence)– that gained particular relevance, offering architects innovative perspectives in the design process. Consequently, this calls for critical and theoretical reflection on drawing's role as an exploratory tool and its integration with emerging digital counterparts [Carazo Lefort, Martínez Gutiérrez 2013].

Drawing, a traditional technique deeply rooted in architecture, plays a pivotal role in exploring ideas and shaping design solutions. It serves as a conceptual "motivating force" [Cook 2008]. However, to comprehensively explore the design landscape, we must also embrace the potential of parametric tools (scripting) and AI-based tools (prompting). These tools facilitate algorithmic and data-driven design approaches, unlocking vast creative, expressive, and communicative potential, empowering architects to chart new graphic territories.

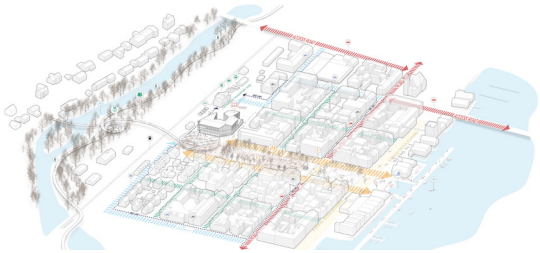
Contrary to the notion of a 'death of drawing' caused by the rise of digital technologies, we propose expanding the expressive possibilities in design by embracing emerging practices connected to advances in computer science: AI, Machine Learning, Big Data, and others.

This study delves into the convergence of these three techniques and their potential to enhance the design process. We explore how their symbiotic use can foster creativity, efficiency, and innovation in architectural design while allowing more time for conceptual development. Additionally, we analyze the challenges and opportunities posed by these techniques, including the impact of new digital technologies such as generative and algorithmic design, and AI-based design automation tools. To achieve this goal, the following objectives are proposed:

- to conduct an analysis of the evolving implications of the digital shift on architectural visualization ex pressiveness and human connection;
- to develop a comprehensive conceptual framework of the impact and integration of scripting languages in architectural design;
- to explore the intersection of architectural creativity and artificial intelligence in prompt-based design.

Comprehending the impact and potential of leveraging science and technology tools in design is crucial for guiding professional practice appropriately and avoiding confusion between means and ends. The research methodology consist of a critical examination of the current state of architectural graphics becomes necessary, exploring the convergence of traditional and digital techniques, along with the transformative potential of new technologies in the design process. Additionally, implications of this hybrid approach for architectural education and the future of the profession should be discussed.

Fig. 1. vi17 arquitectura, analytical axonometry drawing for EUROPAN 16 proposal, 2021.



Drawing: the seductive narrative of technology

In 1983, John S. Gero foresaw that computers would usher in significant changes and innovative approaches to architectural design [Gero 1983]. His foresight became a reality with the widespread adoption of advanced computer software and rendering tools, revolutionizing architectural visualization in the subsequent decades.

In the 1990s, architects started using CAD (Computer-Aided Design) programs to generate intricate and lifelike digital representations of their designs. CAD introduced techniques enabling easy object manipulation, simultaneous multi-image viewing, layer-based tracing, templates, and three-dimensional options [Brandon, McLain-Kark 2001] substantially enhancing precision and efficiency in the design process.

As the new millennium advanced, the development of vector and raster editing programs, along with rendering engines, allowed architects to incorporate lighting, materials, and textures into virtual models. This brought digital representations significantly closer to the final built architecture, making it easier for clients, stakeholders, and the general public to grasp the architect's vision. Consequently, digital visualization became a vital tool for effectively communicating intricate ideas and design concepts, securing competition wins, and attracting new clients.

However, in the mid to late 2000s, concerns emerged about the diminishing expressiveness and uniqueness in architectural representation resulting from the standardization of digital techniques. This standardization occurred after the introduction of each new representation tool in architecture, with the aim of counteracting and transcending towards abstract expression [Iñarra Abad, Juan Vidal, Llinares Millán 2013]. Consequently, various signs and representation techniques adopted a uniform approach, moving away from the analytical nature that characterizes ideation drawing [Franco Taboada 1995], emphasizing selective information for effective communication.

In the 2010s, architects thoughtfully responded by exploring hybrid approaches that seamlessly integrated analog and digital elements in architecture. Through an emerging technique called post-production, architects intricately enhanced their digital representations using manual techniques like freehand drawing, collage,

painting, or photography. This approach revitalized the sensitivity and distinctiveness offered by traditional techniques while harnessing the advantages of digital tools.
As a logical response to counter the loss of expressiveness, architects have adopted *ad hoc* analytical drawings, decrypting the design's qualities and focusing on key aspects (fig. 1). These drawings serve as a potent tool to highlight specific details and convey the conceptual essence of an architectural project more effectively. Through careful selection of elements to emphasize, architects can communicate their ideas with precision, facilitating a deeper understanding among viewers.
Moreover, infographics have become a way to prioritize the narrative aspect of architectural ideas. By combining graphic elements, explanatory texts, and three-dimensional visualization, infographics enable the telling of an immersive story that guides the viewer through the architectural design. This connection fosters an emotional bond with the project, particularly valuable during proposal presentations.
Moreover, renders can integrate contextual elements, illustrating how the project connects with its surroundings and people's daily lives [Anderson 2002]. By emphasizing the experiential and perceptual aspects of places, they evoke a strong connection with the architecture [Fuente Suárez 2016]. This comprehensive view aids viewers in understanding how the architectural project fits into the physical and social reality of its development (fig. 2), transforming architectural design principles through simulations [Llopis Verdú 2018].
In contrast to the post-digital evolution, there is an emerging trend in architectural photography that captures buildings without the presence of people, evoking an atmosphere of distance and solitude. The purpose of these photographs is to emphasize the architecture itself, providing a purer appreciation of its forms, lines, and volumes. However, this trend neglects everyday life and human activities surrounding the buildings, resulting in a loss of context and connection with the true purpose of architectural spaces (fig. 3).
It is interesting to note how these two trends, distant and people-less architectural photography versus the visual narrative that embraces human presence in infographics and architectural representations. These trends reflect the quest for balance between digital technology and artistic expression, ultimately enriching the architectural discourse and pushing architects to explore novel communication methods and design approaches in a rapidly evolving world.

Scripting: the symbolic magic of code

The use of coding languages and scripting techniques, along with parametric and generative design, has sparked a revolution in the field of architecture. These innovations offer architects exciting new avenues for exploring creativity and reimagining the design process [Terzidis 2006; Sakamoto, Ferré 2008; Jabi 2013]. In the realm of digital techniques, architects have achieved novel graphic outcomes that enhance how they visualize and communicate their ideas, proving invaluable both in the design phase and during architectural analysis [Suvanajata 2005].
Scripting has granted architects the power to automate graphic tasks and manipulate data algorithmically, resulting

Fig. 2. Bump Studio, render for EUROPAN 16 proposal, 2021 (digital elaboration by vi17 arquitectura).

in the generation of intricate and organic architectural forms that would have been challenging to create using traditional methods. By leveraging programming languages, architects can fashion parametric structures that adapt and respond to various conditions and requirements [García Alvarado, Jofre Muñoz 2012]. Moreover, parametric design allows for the exploration of design solutions based on predefined rules and parameters, enabling the rapid generation of multiple alternatives and streamlining the creative process [Schnabel 2007]. This, in turn, allows architects to focus on the broader implications of their designs, including the social dimensions [Bhooshan 2017].
On a different note, generative design has pushed the boundaries of computer-aided creativity by blending design principles with algorithms and rules. Through a set of parameters, the system automatically produces a wide range of design options [Wallick 2012]. As a result, architects witness unique graphic outcomes that enable architectural forms to evolve and adapt through an evolutionary and adaptive process. Generative design has proven especially valuable in generating prototype models of building typologies and conducting large-scale building performance simulations [Carnieletto et al. 2021].

Collectively, these techniques offer architects the possibility to explore new ideas and solutions with greater efficiency and precision. Beyond their impact on form and aesthetics, these techniques have also influenced how architects approach their designs, fostering a more open and experimental mindset throughout the design process. Architects can now explore a wide array of options and solutions before making final decisions [Manni, Nicolini 2022].
While visual languages can be beneficial for architecture students to grasp general programming concepts, scripting languages form the bedrock for implementing generative design systems [Celani, Verzola Vaz 2012]. Parametric models can rely on dynamic databases that adjust according to measured variables through sensors, allowing designs to adapt to specific needs. Architecture has begun incorporating data analysis into the design process. Architects now use data to optimize building performance, analyze user behavior, and inform design decisions (figs. 4, 5). Parametric design embodies intentionality, a logic defined by the user that goes beyond mere programmed automation, where the emphasis lies in well-defined problem-solving. Through successive

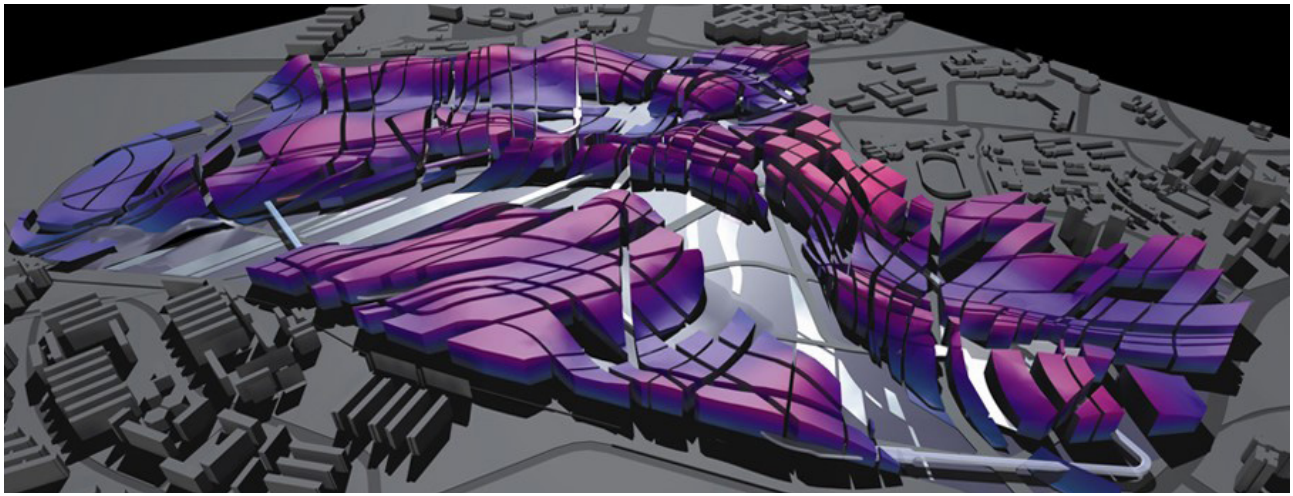
Fig. 3. Photography of uninhabited architecture by López-Chao, 2019. Left: exterior view of the Tenerife Auditorium; right: interior view of the Faculty of Fine Arts of the University of La Laguna (Tenerife).

iterations that integrate multiple variables, different versions emerge, evolving toward the ultimate solution. The role of the designer is pivotal in defining the corresponding relational system, with the graphic results guided by the chosen graphic software.
Viewed as a design tool or strategy, parametricism establishes relationships between elements by assigning values or parameters to master or control complexity, built on principles of connectivity and interrelation [Dunn 2012]. The widespread adoption of these systems [Agkathidis 2016] allows for a cultural approach, viewing them as authentic modes of thought rather than mere tools for creating [Carpo 2017].
This poses the need to comprehend the underlying processes of parametric strategies and scripting languages to consciously utilize these tools in a 'relaxed, pragmatic, and direct' approach that goes beyond mere visualization [Allen 2005]. The idea that the design concept is not preconceived in the designer's mind prompts a disciplinary crisis, positioning us at a juncture between disruption and nostalgia [Picon 2019], compelling us to redefine the relationship between technology and architecture.

Prompting: the intelligent conversation with the machine

"In computer-aided design, only the combination of mechanical amplification and mechanical imitation will validate the dialogue. The dialogue will evolve an intelligence, this intelligence will stimulate a more profound dialogue, which in turn will promote further intelligence, and so on" [Negroponte, 1969a].
The digital revolution in architecture has brought forth new paradigms in design and representation. Artificial Intelligence (AI) tools represent a disruptive technology that optimizes architectural design through algorithmic analysis of vast databases [Castro Pena et al. 2021]. These tools capture structures, identify trends, predict building behavior, and generate compliant floor plan proposals, considering factors such as materials, regulations, geometry, and user flow. They facilitate design decision-making by optimizing spatial layouts, accounting for parameters like natural lighting.
From an architectural visualization perspective, the advent and popularization of AI tools significantly impact the structure of ideation and architectural project design [Leach 2021]. AI-based programs like

Fig. 4. Zaha Hadid Architects, One-North Masterplan, Singapore, 2003.



Stable Diffusion, *Crayon*, *Midjourney*, and *DALL-E* offer novel image production possibilities. As Aaron Betsky highlights in a recent article, the level of realism and painterly effects achieved by these tools ignite a new debate, similar to the introduction of digital tools in the early 1990s [Betsky 2022]. Some technologies enable users to complement a reference image using prompts and predefined variables, such as camera shot type, dominant building material, or architectural style (fig. 6), maintaining control over the final form.
Betsky presents the work of Cesare Battelli, whose aptly named studio Visionary Architecture, utilizes *Midjourney* to create architectural images of fragmentary worlds, where buildings transition from solid to ephemeral as they ascend, and unfinished structures. These renderings exhibit a high degree of realism and painterly effects, set against a characteristic sepia-colored atmospheric backdrop. Battelli skillfully draws upon a palette of references that connect him to the historical tradition of Western art, generating images reminiscent of certain Renaissance painters. Employing an advanced collage model, he assembles preformed materials into a snapshot and artfully conceals its fragmentary origins through the unifying trend of the software.

Fig. 5. Zaha Hadid Archiects, Kartal-Pendik Masterplan, Istanbul, 2006.

The ease of standardizing these trends raises a crucial challenge: maintaining control over the form and design achieved. While many can generate impactful images with a preferred style, the true paradigm shift lies in mastering the art of communicating effectively with the machine while simultaneously analyzing and capturing the essence of architecture and its visualization (fig. 7). Conventional software now integrates AI capabilities, and its evolution emphasizes control over specific variables. However, to truly guide the outcomes, one must possess profound knowledge of the parameters governing image construction. The key to success lies in the theoretical expertise that enables artists to harmonize human creativity with AI-driven tools to produce extraordinary and purposeful architectural representations.
AI algorithm-based image generators offer rapid and efficient exploration of novel architectural concepts, yet they give rise to significant questions concerning creativity, design originality, authorship, and project control [Du Sautoy 2019; Leach 2022]. These tools even hint at the emergence of a new aesthetic tied to the visual imagery they produce, where designers engage in a 'dialogue' or 'conversation' with the digital tool through prompts, as envisioned by Nicholas Negroponte, director of the Architecture Machine Group at MIT in the 1970s [Negroponte 1969b].
The widespread creation of rendered images has spawned a novel aesthetic termed 'post-human aesthetics' by architect Matías del Campo, as it challenges the role of human beings in certain tasks [del Campo 2022]. Images produced through *Midjourney* or *DALL-E* are the outcome of analyzing massive databases fed into the application through machine learning algorithms [Leach 2019]. These results in a peculiar machinic aesthetic, where del Campo refers to the images as 'machine hallucinations' [del Campo, Leach 2022]. These seemingly real results (fig. 8) are in fact reflections of vast databases created by humans, enabling them to reproduce the collective memory of architectural concepts [Lopez-Chao, Fernández-Álvarez, Rodríguez-Grela 2023].
In the view of other researchers, such as Pablo Lorenzo-Eiroa, there exists a critical connection between computation and architectural design, prompting the need to implement collaborative strategies concerning databases. This approach aims to prevent what

Lorenzo-Eiroa refers to as 'digital feudalism', where major corporations dominate global data traffic [Lorenzo-Eiroa 2023]. Collaborative and open-source platforms offer viable alternatives, proposing adaptive processes that surpass traditional planning concepts. These platforms seek to develop architectural solutions that can adapt to diverse usage conditions.
Beyond the aesthetic potential of AI in image production [Leach 2022], its integration into architecture through AIAD (Artificial Intelligence Aided Design) presents a profound challenge to the discipline, re-evaluating the designer's relationship with technology. However, it is crucial not to overlook the significance of these tools as 'invisible assistants' automating design processes, and their impact on redefining the discipline's autonomy. The combination of AI, ML, and Big Data enables the representation of multidimensional spatial environments based on comprehensive information systems [Lorenzo-Eiroa 2019]. Consequently, designers confront the task of determining which aspects of the design process can be fully entrusted to machines and which should remain within human control [Yiannoudes 2023].

Discussion

The exploration of architectural representation in the digital era is not just a chronicle of technological advancements. The journey from traditional drawing to digital platforms brought forth a fusion of styles, blurring the boundaries of individuality. Yet, within this digital fusion, architects found a way to preserve their distinctiveness. The hybrid methods, blending analog sensibilities with digital precision, revitalized the expressive qualities that define architectural spaces and forged a profound connection with human experiences and emotions [Fernández-Álvarez, López-Chao 2022].
The paradigm of parametric design further enriches this discourse. Beyond its computational intricacies, parametric design introduced architects to the realm of data analysis, enabling the optimization of building performance and informed design decisions. Architects found themselves dissecting designs with meticulous precision, analyzing every parameter. The symbiosis of design intent and data-driven analysis became the cornerstone of architectural decision-making.
In the context of AI applications, this analysis takes on new significance. AI, at its core, thrives on data and patterns. The lessons learned from the analytical depth of parametric design provide architects with a unique skill set. Architects, armed with the ability to discern nuances in designs, can guide AI algorithms with a discerning eye. The fusion of human intuition with AI's analytical might become the catalyst for groundbreaking architectural solutions. Architects are no longer passive recipients of AI-generated insights; they are active participants, shaping the architectural futures.

Fig. 6. Automated transformation from axonometry to renders (graphic elaboration by the authors) using Archsynth, based on a 3D model in SketchUp and edited in Gimp. The first iteration without providing instructions and the second one indicating an Art Deco style.

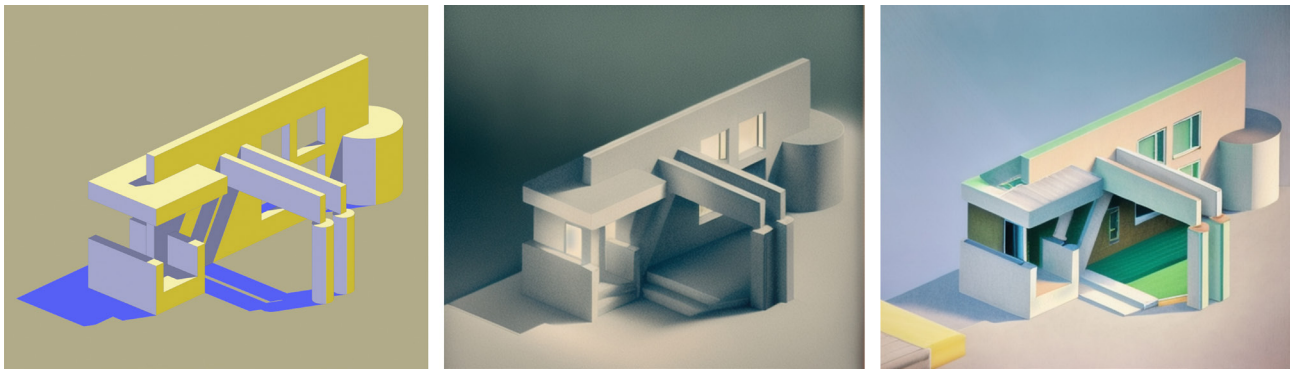


Fig. 7. Stable Diffusion views (digital elaboration by the authors) of an imaginary city where the camera brand, lens, focal length, and lighting type were defined. Environment defined through white concrete.

Conclusions

The integration of digital technology in architecture has significantly advanced the visualization and communication of architectural design. However, striking a balance between digital precision and the artistic expressiveness of hand-drawn sketches remains a crucial challenge in ideation processes [Belardi 2014].
The evolution of drawing as a notation and encoding tool, empowered by various media, goes hand in hand with the emergence of parametric and generative design through scripting techniques. These approaches enable the intelligent analysis and resolution of complex problems, utilizing digital tools' capacity to handle vast data sets. Consequently, this redefines the relationship between architecture and digital technology and welcomes the integration of Artificial Intelligence tools. Through dialogues with the machine (prompting), these tools have the potential to reshape the design process, leading to novel blends and disciplinary trajectories.

Fig. 8. 'Realistic' close-up shots through Stable Diffusion (by the authors).

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