

*Journal of
Art and
Architecture Studies* **J A A S**

ISSN: 2322-455X

Science Line Publication

An international peer-reviewed journal which publishes in electronic format

Volume 11, Issue 2, December 2022

Journal of Art and Architecture Studies

J. Art Arch. Stud., 11 (2): 25-37; December 15, 2022

Editorial Team

Editor-in-Chief

Nilay Özsvaş Uluçay, Interior Architecture & Environmental Designer; PhD in Art, Muğla Sıtkı Koçman University, **TURKEY**; Email: nozsvas@gmail.com

Managing Editors

Nader Ghaemi, PhD Student, Department of Architecture, Islamic Azad University, Tabriz, **IRAN**; Email: nader.ghaemi63@gmail.com

Managing editors

Nader Ghaemi, PhD ([Brief CV](#)), Department of Architecture, Islamic Azad University, Tabriz, **IRAN**; Email: nader.ghaemi63@gmail.com

Language Editors

Samuel Stephen Oldershaw, Master of TESOL, The Humberston School & The Grimsby Institute, Nuns Corner, Grimsby, North East Lincolnshire, **UK**, Email: s.s.oldershaw@hotmail.com

Mehrdad Ehsani-Zad, MA in TEFL, Takestan, Islamic Azad University, **IRAN**, Email: mehrdad_single2004@yahoo.com

Section Editors

Hourakhsh Ahmadnia, PhD; Assistant Prof. of Architecture; Girne American University, **TÜRKİYE**; Email: hourakhshahmadnia@gau.edu.tr

Kianoush Zaker Haghighi, Assistant Prof. of Urban Planning; Islamic Azad University, Hamedan, **IRAN**; Email: k.zakerhaghighi@gmail.com

Editorial Team

Abdel Al Mohammed Abdoun, PhD, Lecturer and researcher at Cairo University, Holds Master in Architectural and Environmental Engineering, **EGYPT**, email: e_abdelal_abdoun@yahoo.com

Ali Hamood Twaij, PhD in Smart Sustainable Design, Assistant professor in University of Baghdad, Kufa University, **IRAQ**; E-mail: alih.abdulhussein@uokufa.edu.iq

Ali Mashhadizadeh Roveshti; PhD; Urban and Regional Planning, Gazi University, Ankara, **TÜRKİYE**; Email: mashhadizadeh54@gmail.com

Aayushi Verma, PhD Junior Research Fellow (UGC), Department of Humanities and Social Sciences, Indian Institute of Technology Roorkee, Uttarakhand, **INDIA**, Email: ayushi03verma@gmail.com

Ayşen Özkan, Assoc. Prof. Dr., Department of Interior Architecture and Environmental Design, Hacettepe University, **TÜRKİYE**; Email: aysenoz@hacettepe.edu.tr

Hourakhsh Ahmadnia, PhD; Assistant Prof. of Architecture; Girne American University, **TÜRKİYE**; Email: hourakhshahmadnia@gau.edu.tr

Ila Gupta, Professor & HOD, Department of Architecture and Planning, Indian Institute of Technology Roorkee, Uttarakhand, **INDIA**, Email: ila.gupta@ar.iitr.ac.in

Johnson Adelani Abodunrin, PhD, Department of Fine & Applied Arts, Ladoko Akintola, University of Technology, Ogbomoso, **NIGERIA**; Email: jaabodunrin@lautech.edu.ng

Justyna Karakiewicz, Associate Prof. of Urban Design; Melbourne University, **AUSTRALIA**; Email: justynak@unimelb.edu.au

Kavos Shahri, PhD in Architecture

from Baku National University, The Faculty of Islamic Azad University of West Azarbaijan, Science and Research Branch, Baku, **AZERBAIJAN**; Email: khavos.shahri@yahoo.com

Mehmet Lütfi Hidayetoğlu, Prof. Dr., Department of Industrial Design, Selcuk University, **TÜRKİYE**; Email: mlhidayetoglu@selcuk.edu.tr

Menşure Kübra Müezzinoğlu, Assist. Prof. Dr., Selcuk University, Faculty of Architecture and Design, Konya, **TÜRKİYE**; Email: kubramznn@selcuk.edu.tr

Mohammad Arif Kamal, PhD, Associate Prof., Architecture & Environmental Design, Aligarh Muslim University, **INDIA**; Email: architectarif@gmail.com

Olusegun Moses Idowu, PhD, Department of Architecture, Modibbo Adama University of Technology, Yola, **NIGERIA**; Email: idowumosegun@gmail.com

Rafooneh Mokhtarshahi Sani, Assistant Prof. of Architecture; Eastern Mediterranean University, **CYPRUS**; Email: sanini@ut.ac.ir

Sarmad Salahuddin, B.Arch, Msc (Pratt, USA), Associate Professor (Tenured) of Architecture, Faculty of Architecture, Lahore College for Women University, Jail road, Lahore, **PAKISTAN**. Email: sarmadsalahuddin@lcwu.edu.pk

Saeed Khosh Niyat, PhD in Architecture

from Baku National University, The Faculty of Islamic Azad University of West Azarbaijan, Science And Research Branch, Baku, **AZERBAIJAN**; Email: saed.kh.arc@gmail.com

Zulina Kamarulzaman; Prof. Dr., Faculty of Design and Architecture, Universiti Putra Malaysia, Serdang, Malaysia Muadzam Shah Polytechnic, Muadzam Shah, Pahang, Malaysia; Email: zulina.q@gmail.com

Volume 11 (2); December 15, 2022

Research Paper

Pixels and columns: tracing the symbiotic evolution of digital graphics and contemporary architecture

Arman Mehr A.

J. Art Arch. Stud., 11(2): 25-37, 2022; pii:S238315532200005-11

DOI: <https://dx.doi.org/10.54203/jaas.2022.5>

ABSTRACT

Technological advancements have rewritten the perspective and functionality of all fields, including art and architecture. This paper delves into the evolution of the symbiotic relationship between digital graphics and contemporary architecture, highlighting their profound impact on architectural representation, design processes, and visual communication. By tracing the historical development of digital graphics in architecture, from initial implementations to the transformative effects of Computer-Aided Design (CAD), we examine how digital graphics have reshaped architectural representation techniques, empowering architects to create realistic renders, animations, and virtual reality applications. The integration of digital graphics into architects' design workflows, especially through parametric design and algorithmic tools, enables the realization of dynamic, responsive architectural forms. Through case studies of iconic structures, the pivotal role of digital graphics in shaping architectural projects is demonstrated. Furthermore, we explore the influence of architectural aesthetics on digital graphics in various industries, such as video games and advertising, emphasizing the importance of ethical considerations in the responsible representation and marketing of architecture. Looking to the future, upcoming technological advancements, including augmented and virtual reality, real-time rendering, and generative design, are predicted to steer architectural innovation and redefine the future of digital design. The seamless interplay between pixels and columns will continue to inspire architects to create innovative, sustainable, and visually striking architectural experiences for future generations.

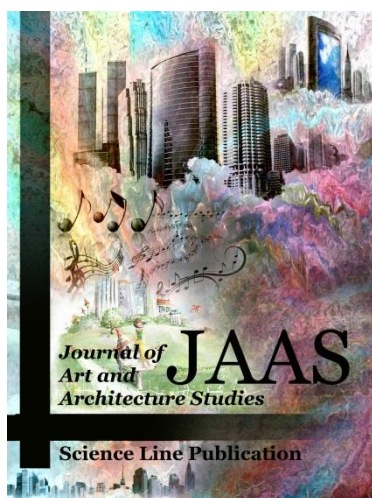
Keywords: Digital graphics, Contemporary architecture, Architectural representation, Parametric design, Virtual reality

[Full text-PDF] [[Crossref Metadata](#)] [Export from [ePrints](#)]



[Previous issue](#) | [Next issue](#) | [Archive](#)

Journal of Art and Architecture Studies



ISSN: 2383-1553

Frequency: Quarterly

Frequency: Biannual (June & December)

Current Issue: 2022, Vol: 11, Issue: 2 (December)

Publisher: [SCIENCELINE](#)

Journal of Art and Architecture Studies aims to promote an integrated and multidisciplinary approach to art and architecture [view aims and scope](#)

<http://jaas.science-line.com>

» Indexed/covered by Ulrich's™, RICEST (ISC), OCLC, TOCs, TIB, ROAD, Genamics, Google Scholar, IndexCopernicus ([view full index information](#))

» Open access full-text articles is available beginning with Volume 1, Issue 1.

» Full texts and XML articles are available in [ISC-RICEST](#).

» This journal is in compliance with [Budapest Open Access Initiative](#).

» High visibility of articles over the internet.

» This journal encourage the academic institutions in low-income countries to publish high quality scientific results, free of charges... [view Review/Decisions/Processing/Policy](#)



PIXELS AND COLUMNS: TRACING THE SYMBIOTIC EVOLUTION OF DIGITAL GRAPHICS AND CONTEMPORARY ARCHITECTURE

Aria ARMAN MEHR  

Department of Art, Islamic Azad University Central Tehran Branch, Iran

Research Article

PII: S238315532200005-11

Received: 18 October 2022

Revised: 10 December 2022

Published: 15 December 2022

✉ Corresponding author:

E-mail:

aryaarmanmehr1@gmail.com

ABSTRACT: Technological advancements have rewritten the perspective and functionality of all fields, including art and architecture. This paper delves into the evolution of the symbiotic relationship between digital graphics and contemporary architecture, highlighting their profound impact on architectural representation, design processes, and visual communication. By tracing the historical development of digital graphics in architecture, from initial implementations to the transformative effects of Computer-Aided Design (CAD), we examine how digital graphics have reshaped architectural representation techniques, empowering architects to create realistic renders, animations, and virtual reality applications. The integration of digital graphics into architects' design workflows, especially through parametric design and algorithmic tools, enables the realization of dynamic, responsive architectural forms. Through case studies of iconic structures, the pivotal role of digital graphics in shaping architectural projects is demonstrated. Furthermore, we explore the influence of architectural aesthetics on digital graphics in various industries, such as video games and advertising, emphasizing the importance of ethical considerations in the responsible representation and marketing of architecture. Looking to the future, upcoming technological advancements, including augmented and virtual reality, real-time rendering, and generative design, are predicted to steer architectural innovation and redefine the future of digital design. The seamless interplay between pixels and columns will continue to inspire architects to create innovative, sustainable, and visually striking architectural experiences for future generations.

KEYWORDS: Digital graphics, Contemporary architecture, Architectural representation, Parametric design, Virtual reality

INTRODUCTION

The continuous advancements in technology have transformed human experience and perspective, reshaping life in all its dimensions. In an era of rapid technological progress, the realms of digital graphics and contemporary architecture have converged to establish a profound symbiotic relationship. The integration of these two fields has redefined the boundaries of architectural representation, reinventing exploration in design and communication.

"Traditional art categorization, limited to painting and sculpture until the early 1960s, gradually evolved with the emergence of Cubist collages and the assertion of photography as an art form" [1]. With the advent of the first computers following World War I, the use of this tool in artistic creation became ready by 1960 and expanded, especially in the field of design, with the growth and innovation of various computer types from the 1970s [2]. In fact, computer graphics have transformed the process of creating drafts and enabled quick entry

and modification of designs. Moreover, "modeling and rendering systems have proven to be valuable aids in the visualization process, allowing designers to move with realistic images of their designs" [3, 4]. In addition, according to Rush [5], today, audiences are not just observers but can actively participate in the creation of artwork, becoming essential elements in its formation. Although Marcel Duchamp considered completing the work of art dependent on these elements, he never imagined that by the end of the 20th century, some works of art would become truly interactive with their viewers and audiences. Not just for completion, but for initiating and enriching the work [5]. Today, to a large extent, interaction and participation are the goals of most contemporary arts, and the role of the audience is emphasized in such a way that in some new works of art, the absence of an audience is inconceivable. Jenkins [6] emphasizes a culture of participation rather than interactive technologies, considering interactivity as belonging to technology and participation as belonging to culture. Park [7] is among the first researchers to create a scale for the

Citation: Arman Mehr A (2023). Pixels and columns: tracing the symbiotic evolution of digital graphics and contemporary architecture. *J. Art Arch. Stud.*, 11 (2): 25-37.
DOI: <https://dx.doi.org/10.54203/jaas.2022.5>



2022 SCIENCELINE

JAAS

Journal of Art and Architecture Studies

ISSN 2383-1553

J. Art Arch. Stud. 12(2): 25-37, Dec 15, 2022

levels of interaction in internet art and classifies online art audiences into three categories: the audience, the user, and the participant. The more an artwork requires the presence of a user, the higher the level of interactivity it has.

This article embarks on a captivating journey, illustrating how digital graphics and contemporary architecture interact, mutually shaping and enriching one another. Understanding the continuous evolution of the intertwining of digital graphics and contemporary architecture is of paramount importance. As architectural methodologies increasingly integrate advanced digital tools and visualization techniques, the resultant visual language deeply influences how we perceive and interact with the constructed environment. The fusion of pixels and columns not only opens new creative opportunities for architects and designers but also plays a pivotal role in shaping the general understanding and comprehension of architectural concepts. This article seeks to illuminate the transformative power of digital graphics in architecture and its far-reaching implications for the future of design.

Literature review

The emergence of digital graphics in architecture can be traced back to the early 1960s, when pioneering architects and researchers began experimenting with computer technology for design and visualization. In its initial stages, digital graphics primarily served as a tool for mathematical and geometrical modeling, enabling architects to explore complex forms and patterns that were challenging to achieve manually.

One of the earliest notable instances of digital graphics in architecture was the pioneering "Sketchpad" developed by Ivan Sutherland. He introduced it at the Massachusetts Institute of Technology (MIT) in Cambridge while working on his doctoral dissertation in 1963. With the help of this program, two-dimensional objects could be displayed on a screen and manipulated using a light pen and an interactive graphics terminal. This innovative program marked the first time that human-computer interaction at a graphic level became possible [8, 9].

In fact, this revolutionary system granted architects the capability to directly draw and manipulate geometric shapes on the computer screen, paving the way for future advancements in computer-assisted design. Architectural design is a repetitive and visual process - one that involves thinking and exploration in visual or symbolic

representations. Coons [10] described the intricacies of design, innovation, and creativity as follows:

"This is an example of a design process where such iterations - from concept to analysis, evaluation, analysis modification, and ultimately to a new concept - form loops that are traversed repeatedly until the designer judges that the scales of judgment are sufficient and balanced [10]. Throughout the 1970s and 1980s, architects and researchers continued to refine digital graphics tools and experimented with wireframe modeling and two-dimensional design systems. With the increase in computational power, the potential for more complex architectural representations also grew. The advent of raster graphics and the use of bitmapped images opened up new possibilities for visualizing architectural concepts with realism and greater detail.

The digital development in the field of architecture has a brief history in which computer-aided design (CAD) played a significant role and is considered a pivotal event in the evolution of digital graphics in architecture. CAD models are often reused for future redesigns, shared in collaborative design teams, and used as a foundation for automated design and shape optimization tools. In this context, the ability of a parametric model to adapt to changes is crucial. This aligns with the concept of "semantic level" in the CAD quality model proposed by Contero and colleagues [11].

CAD has transformed the design process, making the creation of technical drawings, plans, and elevations considerably easier. Architects can now quickly iterate and modify designs, enhancing efficiency and accuracy in architectural documentation. The impact of CAD on architecture goes beyond design and visualization, as it facilitates the generation of precise 3D models, exploration of spatial relationships, and design alternatives. With CAD, architects can visualize projects in a virtual environment and enable better communication with clients and stakeholders. The integration of parametric design principles into CAD systems has empowered architects to create dynamic and adaptable structures, laying the groundwork for a new era of innovative architectural forms.

The evolution of digital graphics in architecture has been profoundly shaped by a series of technological advancements that continuously pushed the boundaries of what was achievable. One notable milestone was the development of the graphical user interface (GUI) in the 1980s, significantly improving the accessibility and usability of design software. The adoption of the GUI

democratized digital graphics tools, allowing a broader spectrum of architects and designers to harness the power of these technologies. The 1990s witnessed increasing advancements, including the widespread adoption of 3D modeling software and the emergence of Building Information Modeling (BIM). BIM marked a transformative shift, primarily focused on evaluating the energy visualization of buildings using BIM-based tools [12]. Because it allowed architects to create intelligent and data-rich models that encompassed not only geometry but also vital project information.

Multiple efforts have been made to categorize the integration of BIM methods with LCA. Anton and Diaz [13] proposed two different approaches to combine BIM and LCA. In the first case, BIM data is directly used in environmental performance calculations. The second type involves a request for environmental attributes to be included in BIM objects. Wastiels and Decuyper [14] provided the most comprehensive classification.

There are also 3D production tools, such as Maya, 3DSMAX, and SketchUp, which represent 3D technology. These additional techniques, such as 3D manufacturing and virtual reality innovations, are incredibly beneficial to planners. They help to increase the effectiveness of their work and allow them to communicate their design thoughts with greater accuracy. With the help of assistive technologies such as augmented environment technology, 3D printing, 2D sketching devices, and 3D manufacturing technology, designers can now work together in one area of design rather than separately [15]. This integration of interdisciplinary expertise has substantially expanded the scope and meaning of the household architecture and layout.

This interdisciplinary integration has significantly expanded the scope and meaning of architecture and interior design. Real-time rendering and visualization technologies enable architects to explore design options with unprecedented realism. Furthermore, the integration of Virtual Reality (VR) and Augmented Reality (AR) technologies empowers architects to immerse themselves and stakeholders in fully interactive architectural environments, transforming the design review processes and client presentations.

So, precise management and a solid foundation for engineering development are two key areas where computer-aided design innovation demonstrates accuracy. By utilizing the powerful computational capabilities to address issues arising during the planning and design processes, designers

can enhance work efficiency and ensure data accuracy in drafting activities [16].

This integration of information has led to increased collaboration, coordination, and decision-making throughout the entire building life cycle. The turn of the millennium brought further advancements. In recent years, the integration of digital graphics with artificial intelligence and generative design algorithms has opened new frontiers in architectural exploration. AI-based tools can analyze extensive datasets and generate design solutions that optimize various performance criteria, pushing the boundaries of architectural innovation [16].

METHODOLOGY

To achieve the specified objectives, this study will adopt a multidisciplinary research approach. Extensive literature reviews through library research will provide the historical and theoretical foundations for exploration. Case studies of iconic buildings and emblematic projects, representing instances of digital graphics integration, will be analyzed to understand practical applications and achievements. Furthermore, in this research, interviews were conducted with certain artists, architects, creators of works, and some audience members to gather more precise information. Additionally, selective interviews were carried out to assess the level of interaction and connection between these two subjects. (Interviews and surveys with architects and experts in this field will be conducted to obtain valuable insights into contemporary methods and future trends.) Moreover, an effort has been made to utilize the cognitive and informational background obtained through fundamental research to take steps toward improving and optimizing patterns, and to articulate the established connection between graphics and architecture.

RESULTS

Digital graphics and architectural representation

Digital graphics use visual elements to represent data and, in fact, utilize the capabilities of these graphic elements and their combinations to support expression. Digital graphics offer unprecedented visual perspectives to architects, allowing them to create realistic images of proposed designs. At the same time, it fundamentally mediates

between the artist, the audience, the text, and the context, which can be considered a distinguishing feature of modern and postmodern art [17].

"Considering the vast field of environmental graphics, its scope of activity and impacts will also be extensive, covering various domains. However, we can categorize its main applications into four general areas: 1) Advertising application; 2) Educational application; 3) Directional and guidance application; 4) Technical application" [18].

In their article, [Bozorgzadeh and Shahkarami \[19\]](#) refer to various types of interactive media, particularly interactive environmental graphics and the new opportunities they create for communication with the audience, emphasizing that interactive media change the flow of information from producers to consumers. [Schrater and Levinson \[20\]](#) also explain in their book, "Visual Usability," that interactive graphics can either be standalone applications or embedded within an application. These images may contain various forms of media such as photography, video, and images, requiring successful image design principles, as well as designing and presenting appropriate controls, and they further explore the capabilities of these various forms.

High-quality rendering engines can accurately simulate lighting conditions, materials, and textures, allowing customers to experience spaces that closely resemble the final built environment. This level of realism enhances understanding, strengthens emotional connections through design, and empowers stakeholders to make more informed decisions.

Furthermore, digital graphics have democratized architectural representation, making it more accessible to a wider audience. Architects can now share their work on various digital platforms, including social media, websites, and online portfolios, to reach a global audience and receive feedback from individuals beyond their professional circle. This increased visibility has the potential to elevate the role of architecture in the public discourse and enrich architectural approaches with diverse perspectives.

Traditional architectural drawings, such as plans, sections, and elevations, served as the primary tools for representation for centuries. These two-dimensional images provided valuable information about spatial arrangements and technical details but often required a certain level of expertise for interpretation and visualization of the final architectural outcome. In contrast, digital renders, animations, and virtual reality applications offer a

more immersive and engaging experience. Renders can depict scenes from various perspectives and show how light interacts with the constructed environment and how materials contribute to the atmosphere. Animations enable architects to convey dynamic features of a design, such as circulation patterns, user experiences, and natural light changes throughout the day. Virtual reality takes representation a step further, allowing stakeholders to directly explore architectural space, interact with it, and experience its scale and proportions with a sense of presence.

The use of digital graphics in architectural representation has multiple advantages and comes with its own set of specific limitations.

Advantages

1. **Advanced Visual Communication:** Graphic design has evolved from two-dimensional graphics to interactive design. This transition has exposed people to a wide range of graphic design methods and styles. With modern media technology and the increasing popularity of media, people now have higher expectations for the aesthetic appeal of media forms. They are no longer satisfied with conventional shapes and are more interested in the overall impact and perceived understanding of what they see [21]. Digital graphics provide clear and convincing representations that facilitate effective communication between architects, clients, and other stakeholders, enhancing understanding and collaboration.

2. **Realism and Immersion:** Designers now have access to a broader range of tools for self-expression, leading to more vibrant and original results. A better understanding of the ocean can be achieved through ocean graphic design, which provides designers with more avenues to express their thoughts [21]. The photorealistic quality of digital renders and virtual reality applications allows stakeholders to envision the design with a level of immersion that traditional paintings cannot achieve. As a result, this stimulates emotional responses and facilitates decision-making.

3. **Iterative Design Process:** Digital tools enable architects to quickly iterate, experiment with design changes, and support a more exploratory and innovative design process.

4. **Advanced Marketing and Visualization:** High-quality digital presentations can significantly aid marketing efforts, attracting potential customers and investors by providing a convincing overview of the proposed architectural project. The product designer considers the development and how people

interact with it, ensuring the final product is not only aesthetically pleasing but also functional and user-friendly. Therefore, designers can tailor the output to precise requirements by conducting in-depth analyses of needs, constraints, and user conditions [22].

Limitations

"The modern world, relying on rationalism, has influenced the contemporary human's comfort and made them solitary in a machine. Modern reason, rather than serving humans, has enslaved them in the mechanized life and put their human characteristics in the background [23]. The most important part in the maintenance and evolution of software systems is dedicated to understanding the system being maintained [24].

1. **Need for Skill and Time:** Effective use of digital graphics, due to its complexities, requires expertise in software and specific techniques, which may necessitate additional training or outsourcing to specialists. Furthermore, handling the large volume of data, consisting of millions of lines of code, needs to be abstracted and analyzed at the architectural level.

2. **Excessive Emphasis on Aesthetics:** Koschke [25] argues that visualization is coupled with functionality, and the impact is solely on the results by configuring graphic elements in visualization tools (by providing a set of features). The nature of digital graphics may lead to an overemphasis on visual aesthetics at the expense of other vital aspects, such as sustainability and performance.

3. **Cost Considerations:** Creating high-quality digital visualizations can be costly, especially for small-scale architectural firms with limited budgets.

4. **Loss of Tactile Sensation:** While digital displays provide comprehensive experiences, they lack the tangible quality of physical models that some stakeholders may find more visually appealing and engaging. Additionally, understanding the structural elements and their interrelationships and gaining an overview of large-scale software systems can be very important but also quite challenging and complex.

Integration of digital graphics in the design process

During the initial stages of the design process, architects often use digital design and 3D modeling software to translate conceptual ideas into visual representations. These digital designs serve as a platform for brainstorming and rapid exploration,

allowing architects to easily iterate and refine design concepts. As the design evolves, architects use digital graphics to analyze and simulate various environmental factors such as solar exposure, wind flow, and thermal performance. This performance-based approach enables architects to make data-driven design decisions and ensure that their creations are not only aesthetically pleasing but also structurally sound and sustainable, as Burry [26] suggests, "the ability to define, determine, and reconfigure geometric relationships holds special value." Furthermore, digital graphics facilitate seamless collaboration and communication among design teams, clients, and stakeholders, enabling the sharing of 3D models, renderings, visualization, and effective feedback exchange, enhancing project coordination and providing a deeper understanding of the design's objectives.

Parametric Design and Algorithmic Tools have emerged as powerful catalysts in shaping contemporary architectural forms, providing architects with tools to create complex, adaptive, and context-responsive structures. Parametric design employs mathematical algorithms to establish relationships between design variables, enabling architects to create models that adapt and respond to changing parameters. Equations can be used to describe relationships between objects, defining a geometry as "a generative geometry interrelated with each other" [26]. Using parametric models, architects can rapidly explore a wide range of design possibilities. Adjusting a single parameter can lead to a spectrum of changes throughout the design, allowing architects to evaluate multiple design iterations and optimize the final solution based on specific performance criteria.

Evolutionary architecture proposes a natural evolutionary process as a means of generating architectural form [27]. In this approach to design, according to Frazer, "architectural concepts are expressed as generative rules, allowing their evolution and development to be accelerated and tested using computer models. Concepts are described in a genetic language that produces a script of instructions for generating form. Computer models are employed to simulate the development of initial forms, which are then evaluated within a simulated environment based on their performance. Algorithmic tools, such as genetic algorithms and cellular automata, provide architects with new ways of generating and optimizing architectural designs. Genetic algorithms mimic natural selection processes and cellular automata use simple rules to

create complex and visually appealing patterns that can define architectural configurations". There are several iconic buildings that serve as primary examples of how digital graphics have played a pivotal role in the design process and shifted the boundaries of architectural innovation.

One of these cases is the Guggenheim Museum Bilbao, designed by Frank Gehry (Figure 1). Digital graphics, especially 3D modeling and parametric

design tools, played a significant role in shaping the iconic form of the museum. The use of digital modeling allowed Gehry and his team to experiment with various iterations, examining different curves and angles to achieve the desired aesthetic and structural coherence. The final appearance and structure effectively showcase the powerful integration of digital graphics in architectural expression.



Figure 1. Guggenheim Museum Bilbao, Spain – <https://www.archdaily.com/>

Another example is the National Stadium in Beijing, also known as the "Bird's Nest," designed by Herzog & de Meuron for the 2008 Beijing Olympics (Figure 2). Digital graphics, including parametric modeling and advanced structural analysis, were essential to realize the intricate and creative network-like structure of the stadium. Digital models facilitated the optimization of the complex geometry, ensuring the structural stability and seismic flexibility while creating an iconic and visually striking architectural landmark.

Furthermore, the Heydar Aliyev Center in Baku, Azerbaijan, designed by architect Zaha Hadid (Figure 3), demonstrates how digital graphics can

manifest in fluid and organic architectural forms. Through the use of digital graphics, including parametric design tools, the center's dynamic curves and sweeping lines have been precisely crafted to evoke a sense of continuous motion and unity. The digital approach empowers architects to explore various design scenarios and fine-tune the aesthetics and performance of the building with precision.

These case studies demonstrate how architects use digital graphics and advanced tools to push the boundaries of architectural creativity, resulting in the creation of astonishing structures that redefine contemporary architectural forms.



Figure 2. National Stadium, China - <https://www.archdaily.com/>



Figure 3. Heydar Aliyev Centre, Azerbaijan - <https://www.archdaily.com/>

DISCUSSION

The impact of contemporary architecture on digital graphics

One of the significant impacts is the emphasis on minimalism and clean lines in contemporary architecture, which has influenced digital graphics and visual communications. The concept of simplicity and irregular design has permeated various industries, from web design to mobile applications, where visual interfaces have become standardized. The minimalist approach not only enhances user experiences but also conveys a sense of modernity and sophistication. Moreover, exploration of dynamic geometries and parametric design principles in architecture has inspired generative art and algorithmic graphics. By using computational methods similar to generating patterns, shapes, and visual sequences, artists and designers can create complex and captivating works of art that resonate with the dynamic qualities often seen in contemporary architecture. The integration of sustainable design principles into architecture has

also increased interest in environmentally and socially compatible design approaches in various industries, leading to a shift towards eco-friendly design in visual communications.

In video games, architects' spatial sensitivities and knowledge of human behavior have been influential in creating comprehensive virtual environments. Architects turned game designers bring a keen understanding of spatial storytelling, getting closer to the design of detailed surfaces, and they create worlds that resonate with players on an emotional and experiential level. Principles of circulation, hierarchy, and scale in architectural design find similarities in the design of game levels, where players navigate through 3D spaces that resemble interactive architectural experiences. Similarly, animation studios utilize architectural principles to craft believable and visually enticing animated worlds. Understanding how structures and environments shape human interactions and emotions is key to creating animated environments that convey depth and narrative authenticity. Architectural design principles help animators

create cohesive environments that immerse audiences in the storytelling and narratives of the animation. Narrative is the organization of clues to create a story. However, narrative structure in computer games significantly differs from narrative organization in other arts. In narrative arts, the text is prearranged and is then read by the audience, who interpret it to construct meaning. According to Barthes [28], a narrative structure is like a text. A text contains signs that generate meaning. In a narrative, there are as many meanings as there are readers. In the contemporary era, the value of an artistic text and its author is no less than that of the audience [29].

In the advertising industry, architectural aesthetics have influenced visual campaigns through the use of architectural images and design concepts to establish a connection with the brand's identity and values. The use of symbolic buildings and urban landscapes in advertising creates a communication link between the brand and its target audience. Simultaneously, "the disorder and chaos in environmental advertising give a distinct and unique visual identity to the urban space" [30]. As Mustafa Asadollahi points out, adhering to the principles and foundations of environmental graphics can help us move away from visual irregularities, ugliness, disorder, and contamination that currently plague the major cities of the country and assist in achieving suitable and beautiful urban environments. He believes that graphic art, as a branch of visual arts, should be employed by urban planners and architects to create high-quality urban spaces [31].

Furthermore, architectural principles such as form and proportion are employed in the design of logos and visual branding elements to ensure visual coherence and recognition. By applying architectural design principles to these areas, the resulting creativity imbues a sense of depth, realism, and spatial cohesion that resonates with the audience, fostering engaging and memorable experiences.

Challenges and ethical considerations

The widespread acceptance of digital graphics in architecture undoubtedly brings numerous advantages to the design and visual representation processes. However, this integration also presents various challenges and potential risks that architects must navigate carefully.

1. One of the significant challenges is the potential for excessive reliance on digital tools and the subsequent loss of tactile interaction in the

design process. "There is a substantial difference between seeing something without a pencil in hand and drawing it" [32]. The act of design involves the ability to react to objects; this is the first step in externalizing an idea. Or as Nauman [33] puts it: "Drawing is equivalent to thinking." Heavy reliance on digital graphics may detach architects from the physicality of materials and construction, limit their imagination, and potentially lead to designs that lack a profound understanding of their materiality and sensory impact. To mitigate this risk, architects must find a balance between digital simulations and physical prototypes that enable practical exploration of design ideas and validation of technical aspects.

2. Another challenge lies in the rapid evolution of digital technologies. Software and hardware platforms are often updated, leading to compatibility issues and the need for continuous learning and training. Corbi [34] mentions that engineers spend up to 50% of their time trying to comprehend the structure of a software system. Nosek and Palvia [35] state that up to 40% of the total effort spent in the lifecycle of a software system is required for (re-) understanding the system during maintenance. Understanding software architectures (i.e., the process of acquiring knowledge about certain characteristics of a software system) is crucial. Architectural firms must invest in the latest tools and ensure that their employees are skilled in effectively using them. Furthermore, a digital divide may exist between established firms that can afford sophisticated tools and smaller companies that may strive to keep up with rapid advancements. This divide has the potential to create disparities in design capabilities.

3. Concerns about data security and privacy preservation also arise with the extensive use of digital graphics in architecture. Design files and sensitive project data may be vulnerable to cyberattacks or unauthorized access, posing a significant risk to intellectual property and client confidentiality. Implementing robust cybersecurity measures and training employees on best practices can help protect against potential data breaches.

As digital graphics and Computer Generated Imagery (CGI) play an influential role in the representation and marketing of architecture, several ethical considerations emerge that architects and designers must address conscientiously.

1. One of the ethical concerns related to the overly realistic nature of CGI and its potential to present architectural projects in an idealized and misleading manner. While CGI allows architects to

showcase their designs with extreme photorealism, there is also the risk of presenting an inaccurately constructed final reality. Providing overly polished and flawless representations may create unrealistic expectations for clients and the public, potentially leading to disappointment once the physical project is completed. To address this issue, architects should maintain transparency in their representation perspective and consider presenting more realistic images that highlight potential flaws and site-related conditions.

2. Furthermore, CGI can influence the social and cultural perception of architecture. When visual architectural works primarily consist of luxurious and advanced projects, it may reinforce social values that prioritize aesthetics and exclusivity. Ethical considerations should encourage architects to use digital graphics in a way that reflects various architectural contexts, universal design principles, and social responsibility. Striving to portray architecture as a medium that addresses social needs and positively contributes to communities strengthens the ethical approach to architectural representation and marketing.

3. There is also an ethical responsibility for the credibility and respect for the participation of artists, graphic designers, and CGI experts who create digital graphics for architectural projects. Proper appreciation and compensation for these individuals ensure ethical treatment of the creative workforce and support a fair and sustainable creative industry.

Future directions and trends

A standard definition of “virtual reality” is hard to find. The Webster Collegiate Dictionary [36] has no definition for it whatsoever. 1 A little over two decades later, we have the following definition: VR is a “computer-generated environment that, to the person experiencing it, closely resembles reality” (Collins Dictionary, [37]). Other definitions of VR emphasize the participatory aspect whereas VR is “experienced” (as opposed to “viewed”) and it is synthetic or fabricated. Addressing the later point, Regenbrecht and Donath [38] have defined VR as “the component of communication which takes place in a computer-generated synthetic space and embeds humans as an integral part of the system...”. Both these points – experience and synthetic – are highlighted by Sherman and Judkins’s [39] five “i”s of VR: “intensive, interactive, immersive, illustrative and intuitive.” These characteristics seem to be a good starting point for a definition. Without one or more of these characteristics there is no VR.

Virtual reality is ultimately a type of “visualization,” a technique which has experienced a recent boom in professional and academic literature. Two special issues, one published in *Environmental Communication* (2013; Vol 7(2)) and the other in *Landscape and Urban Planning* [40], showcase visualization. The former offers a collection of scholarly work now emerging and using various methods in the field of visual environmental communication research. The latter provides a critical view of visualization. Although visualization for environmental and urban planning has numerous dimensions and applications in the literature, there is invariably some mention of virtual reality [41-46]. The future of digital graphics in architecture holds exciting possibilities driven by technological advancements and creative visions. Several trends and innovations are likely to shape the path of digital graphics, improving architectural design, visualization, and communications.

In the first phase, the integration of Virtual Reality and Augmented Reality (VR/AR) has been set up to transform how architects interact with designs and how customers experience architectural spaces. With the continued advancement of VR/AR technologies, architects can immerse themselves in virtual environments to gain a deeper understanding of spatial qualities and ergonomics. Customers and stakeholders can experience designs through augmented reality applications and provide valuable insights before construction begins. The convergence of VR/AR with other digital graphic tools leads to a unified and dynamic design workflow, fostering increased collaboration and exploration in design.

Furthermore, rendering capabilities will continue to improve and allow architects to visualize and modify designs instantly. Real-time rendering engines provide interactive and lifelike representations throughout the design process, reducing the need for time-consuming pre-rendering.

Additionally, advances in generative design and artificial intelligence (AI) will transform architectural exploration. Artificial intelligence algorithms assist architects in creating design options based on specific parameters and performance criteria, simplifying the process of developing innovative and optimal solutions. Generative design tools encourage a data-driven and iterative design approach, leading to the creation of structures increasingly tailored to their contexts and functional requirements.

Several emerging trends have a significant impact on architectural design and representation, shaping the future of architecture.

One prominent trend is sustainable design, which arises from global concerns about climate change and resource depletion. Architects increasingly use digital graphics for energy simulations, life cycle assessments, and environmental analyses. The principles of sustainable design, facilitated by digital graphics, play a crucial role in communicating effective design strategies for green initiatives and the environmental impacts of projects, becoming an integral part of the architectural representation process.

The emergence of parametric and organic forms continues to influence the aesthetics of architecture. Advances in computational design tools empower architects to create innovative and fluid architectural forms that organically respond to specific conditions. Digital graphics play a pivotal role in visualizing these intricate geometries and enable stakeholders to comprehend them. Furthermore, the concept of a smart city integrates digital graphics into urban planning and design. Digital representation of urban landscapes allows urban planners to visualize and analyze data from various sources, enabling informed decisions regarding infrastructure, transportation, and urban development. Another emerging trend is the convergence of digital and physical experiences, where architects blend virtual elements with the real world to create more immersive hybrid environments. Augmented reality enables architects to overlay digital information onto physical models and real-world settings, providing an interactive and comprehensive design review experience.

CONCLUSION

The exploration of the co-evolution of digital graphics and contemporary architecture has shed light on the profound impact of digital graphics on the field of architecture and its coexistence with contemporary architectural practices. Throughout this article, we have delved into the historical evolution of digital graphics in architecture, its integration into the design process, its influence on visual communication in industries, and the ethical challenges and considerations arising from its extensive use. The culmination of these insights underscores the significance of this interaction for the future of architecture and digital design.

In summarizing the main findings, it has been observed that digital graphics have transformed architectural representation techniques, enabling architects to create realistic renders, animations, and virtual reality applications that enhance the understanding and emotional connections with design concepts. A comparison between traditional architectural drawings and digital graphics has highlighted the comprehensive and interactive features provided by digital displays, enhancing design communications and collaboration. The integration of digital graphics into the design process has reshaped architectural methodologies, allowing architects to explore ideas with greater flexibility and efficiency.

Parametric design and algorithmic tools have played a pivotal role in shaping contemporary architectural forms, introducing dynamic and adaptive structures that respond to existing contexts and criteria. The aesthetics and design philosophies of contemporary architecture have been a source of inspiration for digital graphics in various industries, such as video games, animation, and advertising, enriching the visual language and user experiences in these fields. This influence extends beyond aesthetics, encompassing social and environmental considerations, and promotes sustainable and inclusive design approaches.

However, with the extensive use of digital graphics, architects face challenges such as the risk of over-reliance on digital tools and the need to address data security concerns and privacy preservation. Ethical considerations related to the use of computer-generated images in architectural representation and marketing demand transparency, inclusivity, and responsible visualization of design concepts.

DECLARATIONS

Corresponding author

Correspondence and requests for materials should be addressed to Aria ARMAN MEHR; E-mail: aryaarmanmehr1@gmail.com

Data availability

The datasets used and/or analysed during the current study available from the corresponding author on reasonable request.

Competing interests

The author declares that there is no competing interest.

REFERENCES

- [1] Archer M. (2010). *Art After 1960*. Translated by Katayoun Yousefi, 6th edition, Tehran: Honarmand Publications.
- [2] Pakbaz R. (2002). *Encyclopedia of Art (Painting, Sculpture, Graphics)*. 3rd edition, Tehran: Contemporary Culture Publications.
- [3] Glassner AS. (1995). *Principles of Digital Image Synthesis*, Morgan Kaufmann Publishers, San Francisco, CA.
- [4] Greenberg DR. (1991). Computers in Architecture, *Scientific American*, 264, pp. 104-109. DOI: <https://doi.org/10.1038/scientificamerican0291-104>
- [5] Rush M. (2010). *New Media in 20th Century Art*. Translated by Bitā Roshani, Tehran: Cultural Research and Publishing Institute.
- [6] Jenkins H. (2009). *Confronting the Challenges of Participatory Culture: Media Education for the 21st Century*, MIT Press. DOI: <https://doi.org/10.7551/mitpress/8435.001.0001>
- [7] Park JY. (2007). Empowering the user as the new media participant, *Digital Creativity*, 18(3): 175-186. DOI: <https://doi.org/10.1080/14626260701532066>
- [8] Sutherland IE. (2003). *Sketchpad: a man-machine graphical communication system*, technical report, n. 574 (Cambridge), (based on PHD thesis by author submitted in 1963 to the MIT).
- [9] Stenvert R. (1991). Constructing the past: computer-assisted architectural-historical research. The application of image-processing using the computer and computer-aided design for the study of the urban environment, illustrated by the use of treatises in seventeenth-century architecture.
- [10] Coons SA. (1963). An outline for the requirements for a computer-aided design system. *Proceedings of the Spring Joint Computer Conference*, Spartan Books, Baltimore, MD, pp. 299-304.
- [11] Contero M, Company P, Vila C, Aleixos N. (2002). Product data quality and collaborative engineering, *IEEE Comput. Graph. Appl.* 22 (3). 32-42. DOI: <https://doi.org/10.1109/MCG.2002.999786>
- [12] Nizam RS, Zhang C, Tian L. (2018). A BIM based tool for assessing embodied energy for buildings, *Energ. Build.* 170, 1-14. DOI: <https://doi.org/10.1016/j.enbuild.2018.03.067>
- [13] Anton LA, Díaz J, (2014). Integration of life cycle assessment in a BIM environment, *Procedia Eng.* 85, 26-32. DOI: <https://doi.org/10.1016/j.proeng.2014.10.525>
- [14] Wastiels L, Decuyper R (2019). Identification and comparison of LCA-BIM integration strategies, in: *IOP conference series: earth and environmental science*, Vol. 323, No. 1, p. 012101. IOP Publishing, August. DOI: <https://doi.org/10.1088/1755-1315/323/1/012101>
- [15] Mody RN, Bhoosreddy AR (1995). Multiple odontogenic keratocyst: A case report. *Annals of Dentistry*, 54(1-2), 41-43.
- [16] Wang R. (2021). Computer-aided interaction of visual communication technology and art in new media scenes. *Computer-Aided Design and Applications*, 19(S3)(Suppl. 3), 75-84. DOI: <https://doi.org/10.14733/cadaps.2022.S3.75-84>
- [17] Tabaie A. (2014). "The Relationship Between Postmodern Ideas and Indeterminacy: A Comparative Study of Western Philosophy and Art," Tehran: Ney.
- [18] Ilkhani M. (2009). "Environmental Graphics," Tehran: Fatemi.
- [19] Bozorgzadeh Z, Amirshah Karami SNA. (2017). "The Expansion of Interactive Advertising and its Communication Process with the Audience," *Visual Arts*, No. 72, 101-113.
- [20] Schlatter T, Levinson D. (2013). *Visual usability*, Morgan Kaufmann Publishers.
- [21] Liu C. (2022). Artificial intelligence interactive design system based on digital multimedia technology. *Advances in Multimedia*, 2022, 1-12. DOI: <https://doi.org/10.1155/2022/4679066>
- [22] Ahmed MS, Alharahsheh SAM, Ibrahim M, Abdullah I, Omar MH. (2021). Vernacular graphic design: Interactive logos for tourism Terengganu. In *AIP Conference Proceedings (Vol. 2347, No. 1, p. 020187)*. AIP Publishing LLC. DOI: <https://doi.org/10.1063/5.0055691>
- [23] Mahdavezhad MJ. (2004). Pioneering architecture and the link to the past: an essay on identity in the future of Islamic architecture. *Abadi*, No. 46.
- [24] Fjeldstad RK, Hamlen WT (1983) *Application program maintenance study: report to our respondents*. *Proceedings GUIDE 48*, Philadelphia.
- [25] Koschke R (2003) Software visualization in software maintenance, reverse engineering, and re-engineering: a research survey. *J Softw Maint Evol* 15(2): 87-109. DOI: <https://doi.org/10.1002/smr.270>
- [26] Burry M. (1999). *Paramorph*. In *AD Profile 139: Hypersurface Architecture II*. London: Academy Editions.
- [27] Frazer J. (1995). *Evolutionary Architecture*. London: Architectural Association.
- [28] Barthes R, Printz G, Todorov T. (2015). *Introduction to structural analysis of narratives*. Translated by Houshang Rahnama, Tehran: Hermes.
- [29] Panjeh-Bashi E, Hassami M, Arabzadeh J. (2018). "Representation of the Author in the Works of Wafa Bilal and Roland Barthes," *Graphic and Painting Research Journal*, 1(1), 18-27. DOI: <https://doi.org/10.22051/PGR.2019.22199.1013>
- [30] Ghalehnoei M, Modani F. (2010). Positive-negative visual confusion (the role of shop advertising billboards in changing the urban landscape, Chaharbagh-e-Abbasi, Isfahan). *National Conference on Urban Landscape*.
- [31] Doviran I, et al. (2012). Assessment of Visual Comfort Components in Urban Landscape (with Emphasis on the Hosseiniyeh District of Zanjan), *Geography and Environmental Studies*, 1(3), 45-60.
- [32] Valéry P. (2005). *Piezas sobre arte*. Madrid: A. Machado Libros, S.A.
- [33] Nauman B. (1991). Definition of drawing for the Exposition *Drawing & Graphics at Boysman-Van Beuningen Museum of Rotterdam*.
- [34] Corbi TA (1989) Program understanding: challenge for the 1990s. *IBM Syst J* 28(2): 294-306. DOI: <https://doi.org/10.1147/sj.282.0294>
- [35] Nosek JT, Palvia P (1990) Software maintenance management: changes in the last decade. *J Softw Maint* 2 (3):157-174. DOI: <https://doi.org/10.1002/smr.4360020303>
- [36] Webster, M. (1991). *Webster's ninth new collegiate dictionary*. Springfield, MA: Merriam Webster Inc.
- [37] Collins Dictionary (2014). "Virtual Reality". *Collins English Dictionary – Complete & Unabridged 10th Edition*. Retrieved 20 Apr. 2014, from <http://dictionary.reference.com/cite.html?qh=virtual%20reality&ia=ced>
- [38] Regenbrecht H, Donath D. (1997). Architectural education and virtual reality aided design. In D. Bertol (Ed.), *Designing the digital space*. New York: Wiley & Sons Inc.
- [39] Sherman B, Judkins P. (1992). *Glimpses of heaven, visions of hell virtual reality and it's implications*. Great Britain: Hodder and Stoughton.
- [40] Hansen A, Machin D. (2013). Researching visual environmental communication. *Environmental Communication*, 7(2), 151-168. DOI: <https://doi.org/10.1080/17524032.2013.785441>
- [41] Ball J, Capanni N, Watt S. (2008). Virtual reality for mutual understanding in landscape planning. *International Journal of Social Sciences*, 2(2), 78-88.
- [42] Bishop ID, Wherrett JR, Miller DR. (2001). Assessment of path choices on a country walk using a virtual environment. *Landscape and Urban Planning*, 52(4), 225-237. DOI: [https://doi.org/10.1016/S0169-2046\(00\)00118-3](https://doi.org/10.1016/S0169-2046(00)00118-3)

- [43] Ghadirian P, Bishop ID. (2008). Integration of augmented reality and GIS: A new approach to realistic landscape visualisation. *Landscape and Urban Planning*, 86(3–4), 226–232. DOI: <https://doi.org/10.1016/j.landurbplan.2008.03.004>
- [44] Lange E. (2011). 99 volumes later: We can visualise. Now what? *Landscape and Urban Planning*, 100, 403–406. DOI: <https://doi.org/10.1016/j.landurbplan.2011.02.016>
- [45] Paar P. (2006). Landscape visualizations: Applications and requirements of 3D visualization software for environmental planning. *Computers, Environment and Urban Systems*, 30(6), 815–839. <https://doi.org/10.1016/j.compenvurbsys.2005.07.002>
- [46] Portman ME. (2014). Visualization for planning and management of oceans and coasts. *Ocean & Coastal Management*, 98, 176–185. DOI: <https://doi.org/10.1016/j.ocecoaman.2014.06.018>

Publisher’s note: [Scienceline Publication](#) Ltd. remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.



Open Access: This article is licensed under a Creative Commons Attribution 4.0 International License, which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons licence, and indicate if changes were made. The images or other third party material in this article are included in the article’s Creative Commons licence, unless indicated otherwise in a credit line to the material. If material is not included in the article’s Creative Commons licence and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder. To view a copy of this licence, visit <https://creativecommons.org/licenses/by/4.0/>.

Instructions for Authors

Manuscripts as Original Research Paper, Short Communication, Case Reports and Review or Mini-Review are considered for peer-review publishing in *Journal of Art and Architecture studies* (ISSN: 2383-1553), irregularly on the internet. The journal focuses on all aspects of art and architecture... [view full aims and scope...](#)

[JAAS EndNote Style](#)

[Manuscript Template \(MS Word\)](#)

[Sample Articles](#)

[Declaration form](#)

[Policies and Publication Ethics](#)

Submission

The manuscript and other correspondence should preferentially be submit [online](#). Please embed all figures and tables in the manuscript to become one single file for submission. Once submission is complete, the system will generate a manuscript ID and will send an email regarding your submission. Meanwhile, the authors can submit or track articles via jaas@science-line.com or jaaseditors@gmail.com. All manuscripts must be checked (by English native speaker) and submitted in English for evaluation (in totally confidential and impartial way).

Supplementary information

The online submission form allows supplementary information to be submitted together with the main manuscript file and covering letter. If you have more than one supplementary files, you can submit the extra ones by email after the initial [submission](#). Author guidelines are specific for each journal. Our Word template can assist you by modifying your page layout, text formatting, headings, title page, image placement, and citations/references such that they agree with the guidelines of journal. If you believe your article is fully edited per journal style, please use our [MS Word template](#) before submission. **Supplementary materials** may include figures, tables, methods, videos, and other materials. They are available online linked to the original published article. Supplementary tables and figures should be labeled with a "S", e.g. "Table S1" and "Figure S1". The maximum file size for supplementary materials is 10MB each. Please keep the files as small possible to avoid the frustrations experienced by readers with downloading large files.

Submission to the Journal is on the understanding that

- 1.The article has not been previously published in any other form and is not under consideration for publication elsewhere;
- 2.All authors have approved the submission and have obtained permission for publish work.

Graphical Abstract

Authors should provide a graphical abstract (a beautifully designed feature figure) to represent the paper aiming to catch the attention and interest of readers. Graphical abstract will be published online in the table of content. The graphical abstract should be colored, and kept within an area of 12 cm (width) x 6 cm (height) or with similar format. Image should have a minimum resolution of 300 dpi and line art 1200dpi. Note: Height of the image should be no more than the width. Please avoid putting too much information into the graphical abstract as it occupies only a small space. Authors can provide the graphical abstract in the format of PDF, Word, PowerPoint, jpg, or png, after a manuscript is accepted for publication. See more sample graphical abstracts in [archive](#).



Presentation of the article

Main Format

First page of the manuscripts must be properly identified by the title and the name(s) of the author(s). It should be typed in Times New Roman (font sizes: 17pt in capitalization for the title, 10pt for the section headings in the body of the text and the main text, double spaced, in A4 format with 2cm margins (both doc./docx formats). All pages and lines of the main text should be numbered consecutively throughout the manuscript. Abbreviations in the article title are not allowed. Manuscripts should be arranged in the following order:

1. **TITLE** (brief, attractive and targeted);
2. **Name(s) and Affiliation(s) of author(s)** (including post code and corresponding Email);
3. **ABSTRACT**;
4. **Key words** (separate by semicolons; or comma,);
5. **Abbreviations** (those used throughout the manuscript);
6. **INTRODUCTION** (clear statement of the problem, the relevant literature on the subject, and the proposed approach or solution);
7. **METHODOLOGY** (should be complete enough to allow experiments to be reproduced);
8. **RESULTS**;
9. **DISCUSSION**;
10. **CONCLUSION**;
11. **DECLARATIONS** (Acknowledgements, Consent to publish, Competing interests, Authors' contributions, and Availability of data etc.)
12. **REFERENCES**;
13. **Tables**;
14. **Figures**;
15. **Graphs**

Results and Discussion can be presented jointly.

Discussion and Conclusion can be presented jointly.

Article Sections Format

Title should be a brief phrase describing the contents of the paper. The first letter of each word in title should use upper case. The Title Page should include the author(s)'s full names and affiliations, the name of the corresponding author along with phone and e-mail information. Present address (es) of author(s) should appear as a footnote.

Abstract should be informative and completely self-explanatory, briefly present the topic, state the scope of the experiments, indicate significant data, and point out major findings and conclusions. The abstract should be 150 to 300 words in length. Complete sentences, active verbs, and the third person should be used, and the abstract should be written in the past tense. Standard nomenclature should be used and abbreviations should be avoided. No literature should be cited.

Following the abstract, about 3 to 8 **key words** that will provide indexing references should be listed.

Introduction should provide a clear statement of the problem, the relevant literature on the subject, and the proposed approach or solution. It should be understandable to colleagues from a broad range of scientific disciplines.

Methodology should be complete enough to allow experiments to be reproduced. However, only truly new procedures should be described in detail; previously published procedures should be cited, and important modifications of published procedures should be mentioned briefly. Capitalize trade names and include the manufacturer's name and address. Subheadings should be used. Methods in general use need not be described in detail.

Results should be presented with clarity and precision. The results should be written in the past tense when describing findings in the author(s)'s experiments. Previously published findings should be written in the present tense. Results should be explained, but largely without referring to the literature.

Discussion should interpret the findings in view of the results obtained in this and in past studies on this topic. State the conclusions in a few sentences at the end of the paper. The Results and Discussion sections can include subheadings, and when appropriate, both sections can be combined.

Conclusion should be brief and tight about the importance of the work or suggest the potential applications and extensions. This section should not be similar to the Abstract content.

Declarations including Acknowledgements, Authors' contributions, Competing interests, Consent to publish, and Availability of data etc.

Tables should be kept to a minimum and be designed to be as simple as possible. Tables are to be typed double-spaced throughout, including headings and footnotes. Each table should be on a separate page, numbered consecutively in Arabic numerals and supplied with a heading and a legend. Tables should be self-explanatory without reference to the text. The details of the methods used in the experiments should preferably be described in the legend instead of in the text. The same data should not be presented in both table and graph forms or repeated in the text.

Figure legends should be typed in numerical order on a separate sheet. Graphics should be prepared using applications capable of generating high resolution GIF, TIFF, JPEG or PowerPoint before pasting in the Microsoft Word manuscript file. Use Arabic numerals to designate figures and upper case letters for their parts (Figure 1). Begin each legend with a title and include sufficient description so that the figure is understandable without reading the text of the manuscript. Information given in legends should not be repeated in the text.

Declarations

Please ensure that the sections: Ethics (and consent to participate, if any), Acknowledgements, Authors' contributions, Competing interests, Consent to publish, Availability of data and materials are included at the end of your manuscript in a Declarations section.

Acknowledgements

We encourage authors to include an Acknowledgements section. Please acknowledge anyone who contributed towards the study by making substantial contributions to conception, design, acquisition of data, or analysis and interpretation of data, or who was involved in drafting the manuscript or revising it critically for important intellectual content, but who does not meet the criteria for authorship. Please also include their source(s) of funding. Please also acknowledge anyone who contributed materials essential for the study. Authors should obtain permission to acknowledge from all those mentioned in the Acknowledgements. Please list the source(s) of funding for the study, for each author, and for the manuscript preparation in the acknowledgements section. Authors must describe the role of the funding body, if any, in study design; in the collection, analysis, and interpretation of data; in the writing of the manuscript; and in the decision to submit the manuscript for publication.

Authors' Contributions

For manuscripts with more than one author, JAAS require an Authors' Contributions section to be placed after the Acknowledgement section.

An 'author' is generally considered to be someone who has made substantive intellectual contributions to a published study. To qualify as an author one should 1) have made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; 2) have been involved in drafting the manuscript or revising it critically for important intellectual content; and 3) have given final approval of the version to be published. Each author should have participated sufficiently in the work to take public responsibility for appropriate portions of the content. Acquisition of funding, collection of data, or general supervision of the research group, alone, does not justify authorship.

We suggest the following format/example (please use initials to refer to each author's contribution): AB carried out the case studies, participated in the designing and drafted the manuscript. JY carried out the architectural drawing. MT participated in the design of the study and performed the statistical analysis. FG conceived of the study, and participated in its design and coordination and helped to draft the manuscript. All authors read and approved the final manuscript. For authors that equally participated in a study please write '**All/Both authors contributed equally to this work.**' Contributors who do not meet the criteria for authorship should be listed in an acknowledgements section.

Competing Interests

Competing interests that might interfere with the objective presentation of the research findings contained in the manuscript should be declared in a paragraph heading "Competing interests" (after Acknowledgment or Authors' Contributions sections). Examples of competing interests are ownership of stock in a company, commercial grants, board membership, etc. If there is no competing interest, please use the statement "**The authors declare that they have no competing interests.**".

Consent to Publish

Please include a 'Consent for publication' section in your manuscript. If your manuscript contains any individual person's data in any form (including individual details, images or videos), consent to publish must be obtained from that person, or in the case of children, their parent or legal guardian. All presentations of case reports must have consent to publish. You can use your

institutional consent form or our consent form if you prefer. You should not send the form to us on submission, but we may request to see a copy at any stage (including after publication). If your manuscript does not contain any individual persons data, please state "Not applicable" in this section.

Change in authorship

We do not allow any change in authorship after provisional acceptance. We cannot allow any addition, deletion or change in sequence of author name. We have this policy to prevent the fraud.

Data Deposition

In computational studies where the information is unacceptable for inclusion in databases because of lack of experimental validation, the information can be published as an additional file with the article.

REFERENCES

A reference style for [EndNote](#) may be found [here](#). References should be numbered consecutively and cited in the text by number in square brackets [1, 2] (not by author and date). References should not be formatted as footnotes. Avoid putting personal communications and unpublished observations as references. All the cited papers in the text must be listed in References. All the papers in References must be cited in the text. Where available, URLs for the references should be provided.

Examples (at the text):

Smit [1] ...; Smit and Janak [2]...; Nurai et al. [3] reported that ; ... [1], --- [2, 3], --- [3-7].

The references at the end of this document are in the preferred referencing style. Give all authors' names; do not use "et al." unless there are six authors or more. Use a space after authors' initials. Papers that have not been published should be cited as "unpublished". Papers that have been accepted for publication, but not yet specified for an issue should be cited as "to be published". Papers that have been submitted for publication should be cited as "submitted for publication". Capitalize only the first word in a paper title, except for proper nouns and element symbols. For papers published in translation journals, please give the English citation first, followed by the original foreign-language citation.

Examples (at References section):

For Journals:

[1] Hooshyar L, Barugh H (2014). The Role of Tourism in Sustainable Urban Development (Random Sample: Sarein), *J Art Arch Stud.* 3 (2): 95-101.

[2] Popovici, Donici Mihai, Corneliu (2016). Aesthetics of the Main Types of Structures. *J Art Arch Stud.* 5 (1): 13-16.

For In press manuscripts (maximum 2):

Niroumand Shishvan S. (2016). Recognition of Arg-e Ali Shah, Also known as Arg-e Tabriz (Altar of Jama Masjid of Tabriz built in Ilkhanate period I). *J Art Arch Stud.* In press.

For Conference:

Hira A. and Mendis P. (1995). Wind Design of Tall Buildings. Conference on High-rise Buildings in Vietnam. Hanoi, Vietnam. http://archnet.org/library/files/one_file.jsp?file_id=108. Site accessed 3 March 2009.

For Book:

Tavassoli M, Bonyadi N (2007). Design of urban space: urban spaces and their position in life and the image of the city, Second edition, Tehran: Shahidi Press.


For Website:

Bhatti SA and Firkins JT. (2008). http://www.ohioline.osu.edu/sc1156_27.html.

See at <http://www.forbesindia.com/printcontent/41571>

Review / Decisions / Processing / Policy

Firstly, all manuscripts will be checked by [Docol@C](#), a plagiarism finding tool. A single blind reviewing model is used by JAAS for non-plagiarized papers. The manuscript is edited and reviewed by the English language editor and three reviewers selected by section editor of JAAS respectively. Also, a reviewer result form is filled by reviewer to guide authors. Possible decisions are: accept as is, minor revision, major revision, or reject. Authors should submit back their revisions within 14 days (if minor or moderate revision), or 30 days (if major revision).

To submit a revision please [sign in here](#), fill out the form, and mark  Revised, attach the revision (MS word) and submit the revised article. After review and editing the article, a final formatted proof is sent to the corresponding author once again to apply all suggested corrections during the article process. The editor who received the final revisions from the corresponding authors shall not be hold responsible for any mistakes shown in the final publication. Manuscripts with significant results are typically reviewed and published at the highest priority.

Plagiarism: There is a zero-tolerance policy towards plagiarism (including self-plagiarism) in our journals. Manuscripts are screened for plagiarism by [Docol@C](#) a plagiarism finding tool, before or during publication, and if found they will be rejected at any stage of processing.

Declaration

After the manuscript accepted for publication, a [declaration form](#) will be sent to the corresponding author who that is responsible to coauthors' agreements to publication of submitted work in JAAS after any amendments arising from the peer review.

Date of issue

The articles will be published as soon as the final revision received and approved by editorial assistant or EiC.

Publication charges

No peer-reviewing charges are required. However, there is a \$95 editor fee for the processing of each primary accepted paper. Payment can be made by credit card, bank transfer, money order or check. Instruction for payment is sent during publication process as soon as manuscript is accepted.

The Waiver policy

The submission fee will be waived for invited authors, authors of hot papers, and corresponding authors who are editorial board members of the *Journal of Art and Architecture studies* (JAAS). The Journal will consider requests to waive the fee for cases of financial hardship (for high quality manuscripts and upon acceptance for publication). Requests for waiver of the submission fee must be submitted via individual cover letter by the corresponding author and cosigned by an appropriate institutional official to verify that no institutional or grant funds are available for the payment of the fee. Letters including the manuscript title and manuscript ID number should be sent to: [jaas \[at\] science-line.com](mailto:jaas@science-line.com) or [jaaseditors \[at\] gmail.com](mailto:jaaseditors@gmail.com). It is expected that waiver requests will be processed and authors will be notified within 72h.

The OA policy

Journal of World[®] Poultry Research is an open access journal which means that all content is freely available without charge to the user or his/her institution. Users are allowed to read, download, copy, distribute, print, search, or link to the full texts of the articles, or use them for any other lawful purpose, without asking prior permission from the publisher or the author. This is in accordance with the [BOAI definition of Open Access](#).

Scienceline Language Editing Services

We suggest that authors whose first language is not English have their manuscripts checked by a native English speaker before submission. This is optional, but will help to ensure that any submissions that reach peer review can be judged exclusively on academic merit. We offer a Scienceline service, and suggest that authors contact as appropriate. Please note that use of language editing services is voluntary, and at the author's own expense. Use of these services does not guarantee that the manuscript will be accepted for publication, nor does it restrict the author to submitting to Scienceline journals. You can send the article/s to the following [Email: daryoushbabazadeh@gmail.com](mailto:daryoushbabazadeh@gmail.com)

Paper Submission Flow



Submission Preparation Checklist

Authors are required to check off their submission's compliance with all of the following items, and submissions may be returned to authors that do not adhere to the following guidelines.

The submission has not been previously published, nor is it before another journal for consideration (or an explanation has been provided in Comments to the Editor).

The submission file is in Microsoft Word, RTF, or PDF document file format.

Where available, URLs for the references have been provided.

The text is single-spaced; uses a 12-point font; and all illustrations, figures, and tables are placed within the text at the appropriate points, rather than at the end.

The text adheres to the stylistic and bibliographic requirements outlined in the Author Guidelines.

(Revised on 26 June 2021)



SCIENCELINE PUBLISHING CORPORATION

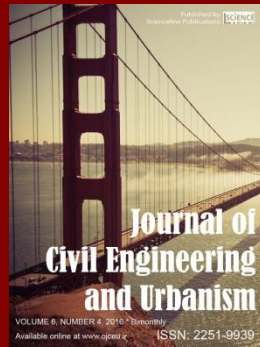
Scienceline Publication Ltd is a limited liability non-profit non-stock corporation incorporated in Turkey (Company No. 0757086921600001). Scienceline journals that concurrently belong to many societies, universities and research institutes, publishes internationally peer-reviewed open access articles and believe in sharing of new scientific knowledge and vital research in the fields of life and natural sciences, animal sciences, engineering, art, linguistic, management, social and economic sciences all over the world. Scienceline journals include:

Online Journal of Animal and Feed Research



ISSN 2228-7701; Bi-monthly
[View Journal](#) | [Editorial Board](#)
Email: editors@ojaftr.ir
[Submit Online >>](#)

Journal of Civil Engineering and Urbanism



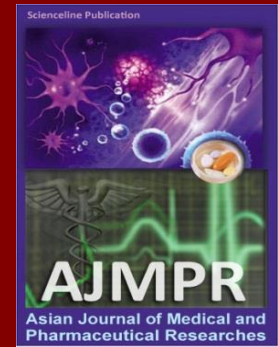
ISSN 2252-0430; Bi-monthly
[View Journal](#) | [Editorial Board](#)
Email: ojceu@ojceu.ir
[Submit Online >>](#)

Journal of Life Sciences and Biomedicine



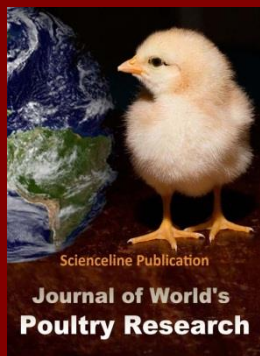
ISSN: 2251-9939; Bi-monthly
[View Journal](#) | [Editorial Board](#)
Email: editors@jlsb.science-line.com
[Submit Online >>](#)

Asian Journal of Medical and Pharmaceutical Researches



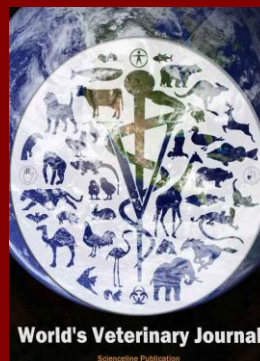
ISSN: 2322-4789; Quarterly
[View Journal](#) | [Editorial Board](#)
Email: editor@ajmpr.science-line.com
[Submit Online >>](#)

Journal of World's Poultry Research



ISSN: 2322-455X; Quarterly
[View Journal](#) | [Editorial Board](#)
Email: editor@jwpr.science-line.com
[Submit Online >>](#)

World's Veterinary Journal



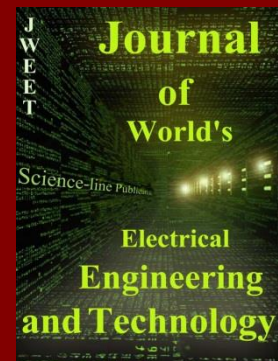
ISSN: 2322-4568; Quarterly
[View Journal](#) | [Editorial Board](#)
Email: editor@wjv.science-line.com
[Submit Online >>](#)

Journal of Educational and Management Studies



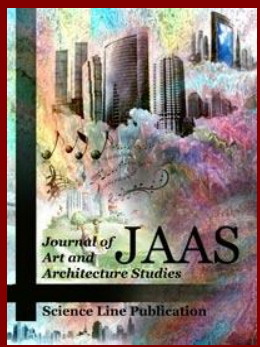
ISSN: 2322-4770; Quarterly
[View Journal](#) | [Editorial Board](#)
Email: info@jems.science-line.com
[Submit Online >>](#)

Journal of World's Electrical Engineering and Technology



ISSN: 2322-5114; Irregular
[View Journal](#) | [Editorial Board](#)
Email: editor@jweet.science-line.com
[Submit Online >>](#)

Journal of Art and Architecture Studies



ISSN: 2383-1553; Irregular
[View Journal](#) | [Editorial Board](#)
Email: jaas@science-line.com
[Submit Online >>](#)

Asian Journal of Social and Economic Sciences



ISSN: 2383-0948; Quarterly
[View Journal](#) | [Editorial Board](#)
Email: ajses@science-line.com
[Submit Online >>](#)

Journal of Applied Business and Finance Researches



ISSN: 2382-9907; Quarterly
[View Journal](#) | [Editorial Board](#)
Email: jabfr@science-line.com
[Submit Online >>](#)

Scientific Journal of Mechanical and Industrial Engineering



ISSN: 2383-0980; Quarterly
[View Journal](#) | [Editorial Board](#)
Email: sjmie@science-line.com
[Submit Online >>](#)

[ABOUT](#)
[AIMS AND SCOPE](#)
[LEADERSHIP TEAM](#)
[WHO WE WORK WITH](#)
[POLICIES AND PUBLICATION ETHICS](#)
[TERMS AND CONDITIONS](#)
[CONTACT](#)

Scienceline is a non-profit organisation inspired by research funders and led by scholars. Our mission is to help researchers accelerate discovery and innovation by operating a platform for research communication that encourages and recognises the most responsible behaviours in science.

Scienceline Publications, Ltd is a limited liability non-profit non-stock corporation registered in the State of Erzurum, Turkey, with company number 0757086921600001, and branch number 18677/25379 at the address: [Scienceline Publications, Ltd.](#), Ömer Nasuhi Bilmen Road, Dönmez Apart., G/16, Yakutiye, Erzurum 25100, Turkey