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LEVERAGING LANDSCAPE ARCHITECTURE AND ENVIRONMENTAL STORYTELLING FOR NEXT-GENERATION GAMING EXPERIENCES

A Holistic Approach to Virtual World Design

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Abstract. Designing a virtual environment within a digital game occupies a large part of the design procedure, requiring holistic attention and a broad arrangement of the game constituents. Considering other design disciplines, they occupy a unified design methodology; however, a comprehensive literature review reveals the lack of the intended design methodology in the digital game domain's virtual environment development, despite a currently proposed theoretical methodology trying to dissolve the issue. Hence, this research aims to determine the industry's requirements and provide a set of assets included in current digital games as an initial step of providing such a design methodology for the domain. In this regard, the researchers reverse-engineered ten selected digital games, understanding the current condition of digital games via adopting the mentioned currently available design methodology. This dataset reveals a lack in the assets of the story layer in the recent digital games, despite their focus on being story-based. This dilemma leads to long text or speech conversations between game characters, disrupting the players while following the game. The current design focuses on environmental resources only, however, as a virtual landscape, the story needs to be reinforced to be a balanced and well-designed game. Hence, increasing the ratio of the assets in this layer will advance the games' interactivity. Also, as future work, this data set could pave the

way for a digital game industry design tool regarding the virtual environment.

Keywords: Digital game, Level design, Landscape Architecture, Virtual Environment.

ملخص. يشغل تصميم بيئة افتراضية ضمن لعبة رقمية جزءًا كبيرًا من إجراءات التصميم، ويتطلب اهتمامًا شاملاً وترتيبًا واسعًا لمكونات اللعبة. عند النظر في التخصصات التصميمية الأخرى، فهي تحتل منهجية تصميم موحدة؛ ومع ذلك، يكشف استعراض الأدبيات الشامل عن نقص في المنهجية التصميمية المقصودة في تطوير بيئة اللعبة الرقمية الافتراضية، على الرغم من المنهجية النظرية المقترحة حاليًا التي تحاول حل المشكلة. وبالتالي، تهدف هذه الدراسة إلى تحديد متطلبات الصناعة وتقديم مجموعة من الأصول المدرجة في الألعاب الرقمية الحالية كخطوة أولية لتقديم منهجية تصميم مثل هذه للمجال. في هذا الصدد، قام الباحثون بالهندسة العكسية لعشر ألعاب رقمية مختارة، فهموا الحالة الحالية للألعاب الرقمية من خلال اعتماد المنهجية التصميمية المتاحة حاليًا. يكشف مجموع البيانات هذا عن نقص في أصول طبقة القصة في الألعاب الرقمية الحديثة، على الرغم من تركيزها على أن تكون قائمة على القصة. هذا الجدال يؤدي إلى محادثات نصية أو خطابية طويلة بين شخصيات اللعبة، مما يعكر صفو اللاعبين أثناء متابعة اللعبة. يركز التصميم الحالي فقط على الموارد البيئية، ومع ذلك، كمناظر طبيعية افتراضية، يجب تعزيز القصة لتكون لعبة متوازنة ومصممة بشكل جيد. وبالتالي، سيؤدي زيادة نسبة الأصول في هذه الطبقة إلى تقدم تفاعل الألعاب. أيضًا، كعمل مستقبلي، يمكن أن يمهد مجموع البيانات هذا الطريق لأداة تصميم صناعة الألعاب الرقمية فيما يتعلق بالبيئة الافتراضية.

الكلمات المفتاحية: لعبة رقمية، تصميم المستوى، تنسيق المواقع، البيئة الافتراضية.

1. Introduction

Among global industries, the digital game industry, with its large market size, is a fast-growing one with an average rate of 11% per year since the 1962s (Hudrasyah et al., 2019), the development year of the first computer game ever (Zackariasson and Wilson, 2010). Currently, its market size is rising above the digital media market (Lange et al., 2021) and surpassing the movie and music industries in revenue (Guðjónsson, 2020). The rise of mobile gaming has significantly contributed to this growth, with mobile games accounting for nearly half of the global games market in recent years (Newzoo, 2019). In more detail, the digital game market generated 196.8 billion USD in revenue for 2022 and is estimated to increase to 268.8 billion USD in 2025 (Newzoo, 2022; Statista, 2023). Specifically, with the COVID crisis emerging, the digital game market trend in 2020 has been influenced. More people prefer indoor activities to avoid infection; accordingly, the game industry is developing more actively (Unity, 2020). E-sports, too, has seen a surge, with its global audience growing to nearly half a billion in 2020 (Statista, 2020). Even after the crisis ended, such a growth trend did

not end. Hence, the design process of digital games is getting more critical than ever in the current era. Since the market size is getting more extensive than ever, more people are playing games. Additionally, people are asking for more advanced and sophisticated levels of games. This level is highly dependent on the level of the virtual landscape due to taking the most significant part of the content.

The advancements in game engines, like Unreal Engine and Unity, have enabled developers to create more immersive and realistic game worlds. However, to develop a digital game, the developers should consider various aspects of design, including a detailed virtual environment, as the most time-consuming one, requiring a comprehensive consideration of the game's multiple components through a considerable number of human resources (Kim, 2020). According to Choi (2010), the effort required to design a virtual environment in a digital game equals the amount needed to develop the game. Hence, designing and building it is the same as real space. Furthermore, the characteristics of the digital game are indeed the characteristics implied by its virtual environment (Apperley, 2006). The intricacy of these virtual environments has grown with the advancement of technology, demanding more detailed graphics, realistic physics, and dynamic interactions, further complicating the design process (Anderson, 2012; Eshaghi et al., 2021). However, finding a standardized design methodology for designing and producing any virtual environment is challenging. Therefore, digital game companies follow various methodologies for each project they start, which requires a significant share of work and time (Huijser et al., 2010; Kim et al., 2018; Afshar et al., 2022). This lack of standardization often leads to increased costs and extended development cycles, especially when teams need to familiarize themselves with different methodologies for each new project (Sotamaa, 2010). Hence, with the absence of a unified and standardized design methodology, the virtual environment design process is inefficient, with low quality and unstable results (Kim, 2020; Afshar et al., 2022). Moreover, the rapid evolution of gaming platforms and user expectations further exacerbates these challenges, making it imperative for the industry to consider more streamlined approaches (Juul, 2010).

On the other hand, various domains such as architecture, landscape architecture, and urban planning have been applying multiple design methodologies throughout history, easing the space creation process and leading to better quality results. Unfortunately, such a concept is currently lacking in the digital game industry. With this background, a methodological design approach is needed for the digital game industry, accessible by understanding and applying the current situation and the solution to the lacking parts. Hence, as the first stage to fulfill this lack, the research aims to

determine the game industry's requirements to propose a dataset of the available virtual environment assets in various digital games. This dataset could enable the development of a possible future tool to ease the digital game industry's process in the virtual environment part of game development.

2. Literature Review

Studies focusing on the virtual environment are available in the literature; however, figuring out the existing research, notably, all the researchers took advantage of virtual spaces to design a better real space in landscape architecture, architecture, and urban design. Throughout a comprehensive literature review, we can instance the following examples. Landscape architects can visualize a concept or idea, or architects can archive their designs more efficiently via a comprehensive understanding of the virtual space as a tool (Portman et al., 2015). 3D virtual spaces can be used for more accurate duplication and analysis of real space gardens (Li and Dawei, 2017; Wang and ZhenNan, 2010). For a more efficient design of real spaces, an automated methodology and program had been developed for the landscape architects (Deussen, 2003). Also, to design and present the landscape architect's idea more efficiently, two existing studies tried to propose a new methodology using virtual space (Lombardo, 2018; van Lammeren et al., 2002). Moreover, the use of virtual space for efficient landscape architecture education is another focus of the researchers. Johns and Russell (2005) treat the digital game engine, a virtual environment design tool, as an education method for students. In another similar attempt, Francis (2001) focused more on observing and preserving landscape architecture case studies. Additionally, in the literature, Building Information Modeling (BIM) or Landscape Information Modeling (LIM) is used as a tool to simulate real space virtually by combining them with virtual spaces and game engines (Ahmad and Aliyu, 2012; Boeykens, 2011; Döllner and Hagedorn, 2007; Ma and Bing, 2017).

The main focus of the existing studies about the virtual environment is oriented around using it as a tool to pave the way for efficiency or quality in real-space design. Despite this, enhancing the quality of the virtual environment by using real space design techniques has rarely been studied. For instance, visionary architecture that facilitates the architects to pass beyond the real restrictions and visualize their exemplary ideas virtually (Collins, 1968) has highly superficial results that play a critical role in space design. The drawing of Herron as the 'Walking City' (Ron, 2021) or Sant'Elia's vision of the future urban environment (Landes, 2016) are some examples of the issue. However, since the outcomes are visual materials

showing the architect's abstract concept, it would be controversial to call them interactive spaces. So, even this sample of using the virtual environment as a design domain is not adequately efficient in enhancing real space.

Regarding the studies considering the virtual environment as a design area, references are still rare (Kim, 2016; Kim et al., 2018; Kim, 2020). This research series adopts the design methodology of landscape architecture, architecture, and urban planning domains to enhance the efficiency and quality of the virtual environments. In more detail, firstly, the researchers compare and analyze the differences between real and virtual spaces as a design domain (Kim, 2016), discovering the classification possibility of virtual landscapes based on their characteristics compared to real spaces. In this research, a classification methodology is first proposed, and then the researcher developed a digital game design methodology (Kim et al., 2018) validated with the comparative experiments (Figure 1).
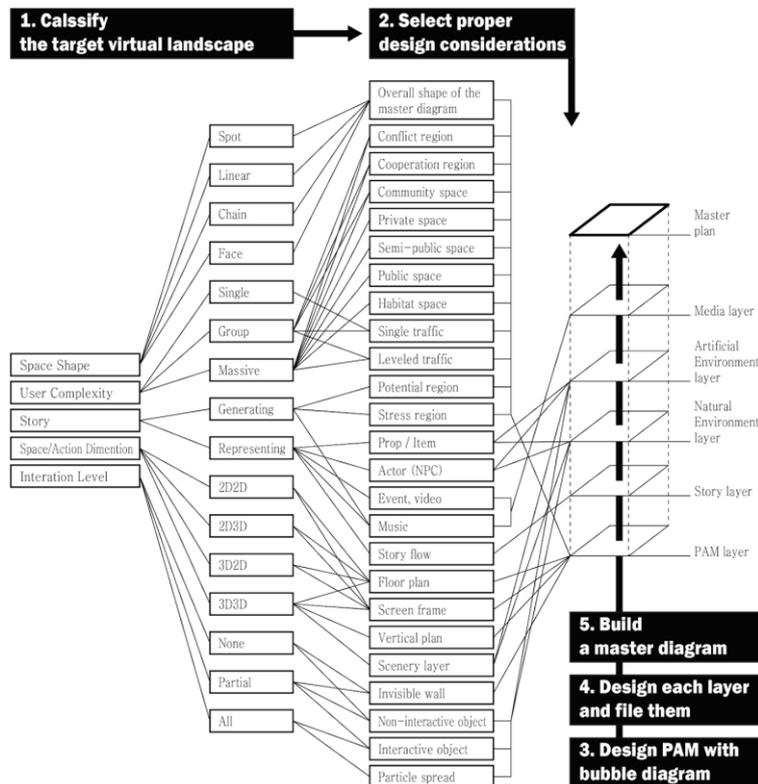

Figure 1. Digital game classification and design methodology.

As the research results indicate, designers who have learned the methodology experienced 15 times higher work efficiency and more than three times higher cooperation with their mates. Additionally, the final results were highly satisfactory in terms of quality (Bazin and Kim, 2018). So, for this reason, we decided to adopt Kim's design methodology as the primary reference of the study.

3. Methodology

Since the research aims to understand the requirements of the game developers, designers, and artists, the first step of the study is to determine the needs of a digital game regarding its virtual environment, including a comprehensive set of the most used assets. To do so, Kim's theoretical methodologies (Kim, 2020) were applied to digital games to find out if it is possible to adapt these methodologies to various types of games. Since the research assembles the elements of the existing digital games, reverse engineering is used to segregate the games into their components. In our previous studies, we classified all the Steam games with the education tag based on the same methodology (Afshar et al., 2022) and data mined all the historical Steam games (Eshaghi et al., 2023); this time, we selected ten digital games for reverse engineering. In the game selection part, we used the IGN database, which is released as the top 100 video games of all time (IGN, 2021). In this list, we randomly selected the games published after 2010, regardless of their platform, to include any device's recent games. The other criterion for choosing the games was the amount of their focus on the virtual environment part of the game because of the research's target.

The research includes digital games with different classification codes based on Kim's game classification methodology to include various types of games in the pool. However, the similarities in the codes will be discussed in the continuation of the paper. This variation enables us to gather as much varied information as possible. Based on the mentioned principles, we selected ten games, given in Table 1, and provided their release date, developer(s), and classification code. For the reverse engineering of the selected games, the research considered each game's first level and tutorial to be played. Because they are places for beginners, and logically, we could assume that the designers put the most effort into them.

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TABLE 1. List of Reversed Engineered Games.

#	Game Title	Release Date	Classification	Developer(s)
1	Journey	2012	GR33FP	Thatgamecompany, Santa Monica Studio, Tricky Pixels
2	Diablo III	2012	GR32SP	Blizzard Entertainment
3	Borderlands 2	2012	GR33CP	Gearbox Software, Aspyr, Aspyr (Mac)
4	Grand Theft Auto V	2013	MR33FP	Rockstar Games, Rockstar North, MORE
5	The Last of Us Remastered	2014	SR33CP	Naughty Dog
6	The Witcher 3: Wild Hunt - Game of the Year Edition	2015	SR33FP	CD Projekt, CD Projekt RED
7	Inside	2016	SR32LP	Playdead
8	Divinity: Original Sin II	2017	GR32CP	Larian Studios, Elverils
9	Fortnite	2017	MG33FA	Epic Games, People Can Fly
10	Red Dead Redemption 2	2018	GR33FP	Rockstar Games, Rockstar North

In the second stage, we classified all the elements in the games to the natural environment, artificial environment, story, and media layers. To be precise, it would have been better if we could approach the raw data of the games and count the number of assets and effects. However, since these data are protected as the developers' property and it was not possible to approach them, we took four screenshots of each game's first level for doing such a classification and counted the assets manually. We focused on the parts with the most available elements while taking the screenshots. Then we signed all the visible elements in the scene and defined codes for them based on the game's title and its layer. Afterward, we prepared a comprehensive table including the layer, category, asset code, type, name, interaction, detail, and the image file number for each game's assets. Subsequently, the number of assets in each level and their characteristics were analyzed. Table 2 demonstrates a brief asset list of ten reverse-engineered games, and Table 3 shows the number of assets in each layer.

TABLE 2. Brief Asset List of The Ten Selected Games.

Layer Name	Asset Types
Natural Environment Layer	Shrub, Paving, Water, Area, Object, Ruined, Grass, Flower, Tree, Underbrush, Hill, Moon, River, Mountain, Area, Sky
Artificial Environment Layer	Building, NPC, Fire, Human, Object, Smoke, Car, Tower, Road
Media Layer	Sound, Video, Viewpoint
Story Layer	Sound, Video

TABLE 3. The Number and Percentage of Assets in Each Layer of All Games (Dark Grey Columns Demonstrate the Most Assets, and the Light Grey the Least).

#	Game Title	Classification	Number and percentage of assets in each layer							
			Natural Environment Layer		Artificial Environment Layer		Media Layer		Story Layer	
			Number	Percentage	Number	Percentage	Number	Percentage	Number	Percentage
1	Journey	GR33FP	9	21.4%	17	40.5%	13	31.0%	3	7.1%
2	Diablo III	GR32SP	35	35.7%	28	28.6%	21	21.4%	14	14.3%
3	Borderlands 2	GR33CP	8	14.5%	35	63.6%	8	14.5%	4	7.3%
4	Grand Theft Auto V	MR33FP	16	23.9%	33	49.3%	14	20.9%	4	6.0%
5	The Last of Us Remastered	SR33CP	8	16.3%	21	42.9%	14	28.6%	6	12.2%
6	The Witcher 3: Wild Hunt - Game of the Year Edition	SR33FP	44	47.3%	15	16.1%	23	24.7%	11	11.8%
7	Inside	SR32LP	33	45.8%	12	16.7%	20	27.8%	7	9.7%
8	Divinity: Original Sin II	GR32CP	12	12.9%	60	64.5%	14	15.1%	7	7.5%
9	Fortnite	MG33FA	33	41.8%	12	15.2%	23	29.1%	11	13.9%
10	Red Dead Redemption 2	GR33FP	28	28.9%	22	22.7%	19	29.9%	21	18.6%

Notably, the randomly selected games have a similar digit in their codes. According to Kim, the code's second digit expresses the story type of the game as representing or generating. As Table 1 depicts, nine of ten played games have an R code in their second digit, while only Fortnite (2017) has a G code in this digit. To explain more in detail, the paper provides the coded screenshots of The Last of Us Remastered (2014) as a sample of a representing game and Fortnite (2017) as a generating one (Figure 2 and Figure 3). Additionally, Figure 4 shows their asset ratio in each layer, demonstrating the focus of each game's elements on a specific layer. For instance, the Last of Us Remastered (2014) analysis depicts that the assets are focused mainly on the artificial environment layer, with 42.9%, and the Fortnite (2017) game focused its assets on the natural environment layer, with 41.8%.
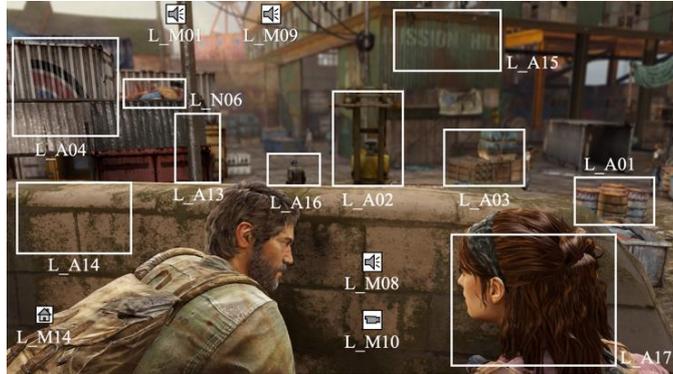
Figure 2. Sample of a coded screenshot of The Last of Us Remastered game (2014)

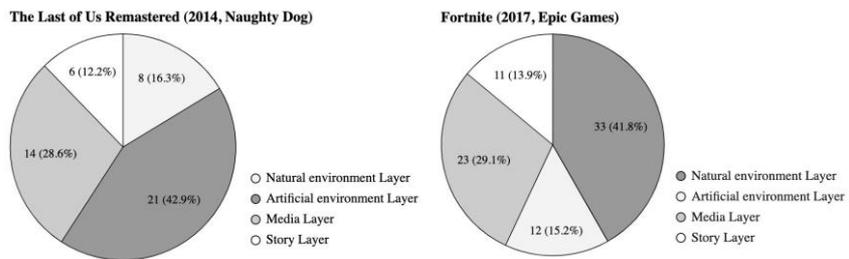*Figure 3.* Sample of a coded screenshot of The Fortnite game (2017)

Figure 4. Asset Ratio Sample

Concluding these data for all ten games leads us to the point that the story layer consists of the least number of assets among the others. Even considering the game's background environment, which is an abandoned urbanscape, we can assume that game developers paid more attention to the natural and artificial layers. However, the ratio of the games shows that the

significant majority of current digital games have a storytelling theme. This suggests a potential disconnect between the narrative intent and the actual asset allocation in game development.

4. Conclusion

To conclude, the digital game industry, a realm of innovation and creativity, currently faces a discernible gap in its methodological approach, especially when it comes to the design of virtual environments. Kim's pioneering proposition, which introduces a digital game classification and design methodology inspired by architecture, landscape architecture, and urban planning, offers a fresh and potentially transformative perspective. This research, in its essence, seeks to bridge the theoretical with the practical, aiming to discern the applicability of Kim's methodologies across a diverse spectrum of games.

Through an exhaustive process of playing and reverse engineering a curated selection of ten games, we've amassed a comprehensive data set. Developed with a meticulous coding system, this set categorizes the myriad assets employed within these games. However, the constraints of this study, particularly the manual counting of assets due to the inaccessibility of raw game data, underscore the challenges inherent in such research. Furthermore, the limited sample size of games analyzed, suggests that for a more robust and definitive conclusion, a broader and more diverse selection of games would be instrumental.

Our findings, while preliminary, are illuminating. They not only shed light on prevailing industry trends but also highlight its glaring gaps. It's particularly noteworthy that while the majority of contemporary games are steeped in narrative-driven themes, there's a conspicuous absence of assets dedicated to the story layer. This reliance on character dialogues and in-game texts for narrative delivery, while effective for some, can potentially alienate a segment of players, leading to a diminished gaming experience. Moreover, such an approach inadvertently creates linguistic barriers, narrowing the game's appeal to those proficient in specific languages.

Our research underscores the potential benefits of enriching the story layer with a diverse array of assets, thereby fostering a more immersive and linguistically inclusive gaming experience. The broader implications of this are profound, suggesting a shift towards games that are not only more engaging but also more globally accessible. By integrating Kim's digital game design methodology, there's an opportunity to usher in a new era of game design, one that's holistic and considers every facet of the virtual environment.

Furthermore, the synthesis of our data set with Kim's methodologies lays the groundwork for future innovations, particularly the potential development of a specialized tool tailored for the digital game industry. Such a tool could be revolutionary, equipping professionals with the means to allocate equitable attention to all game layers, thereby fostering the creation of more balanced and holistic digital games. This, in turn, could streamline the game development process, ensuring optimal utilization of labor, time, and financial resources.

In the grand tapestry of game design, the threads of innovation, methodology, and inclusivity must intertwine. As the industry continues to evolve, it's imperative to embrace methodologies like Kim's, ensuring that games of the future are not only technologically advanced but also rich in narrative depth and universally accessible. The horizon of game design beckons, and with the right tools and approaches, the industry stands on the cusp of a renaissance.

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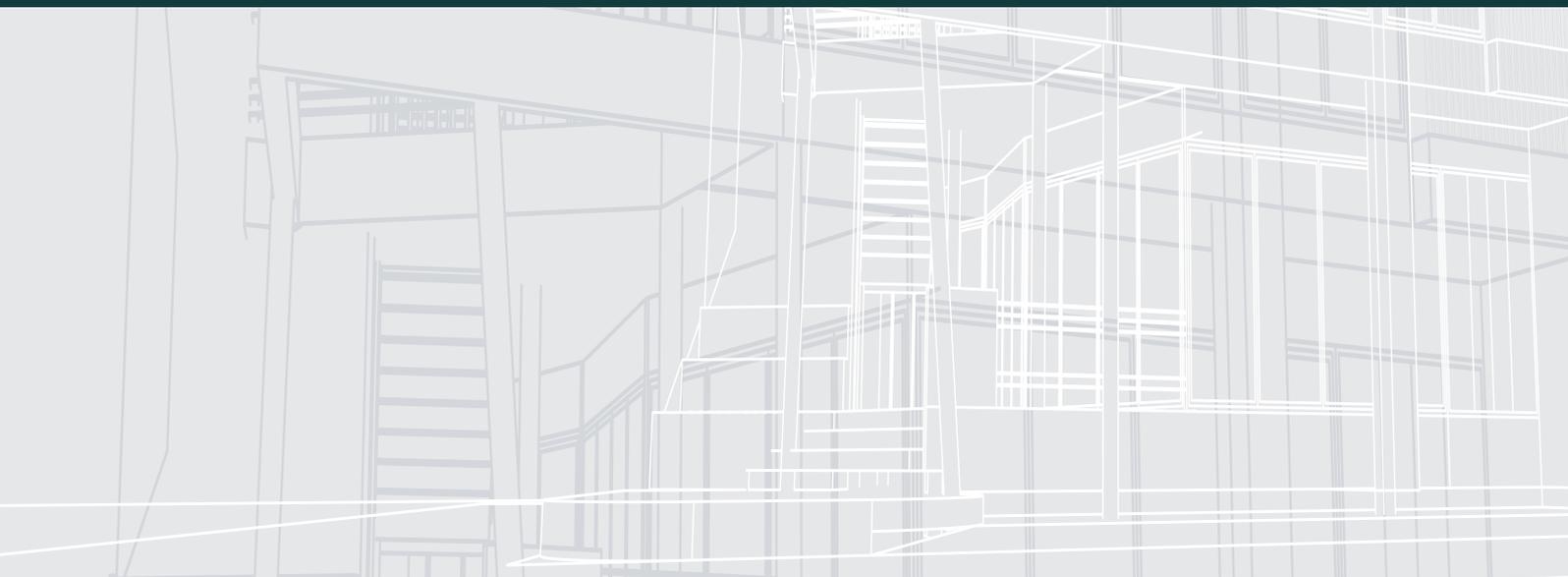LEVERAGING LANDSCAPE ARCHITECTURE AND ENVIRONMENTAL
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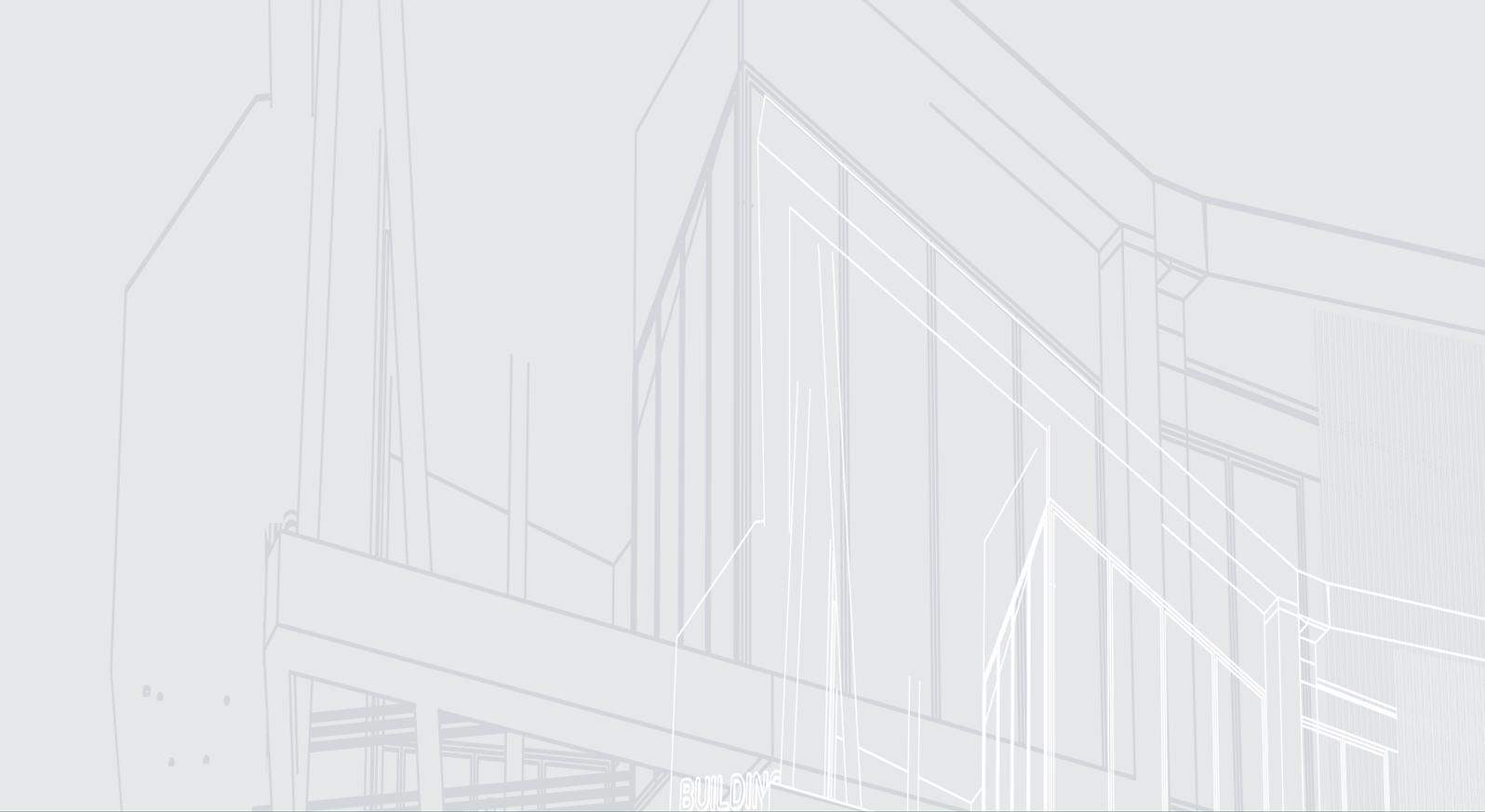
The ASCAAD 2023 theme focuses on Computation, Culture, and Context; a triad that is increasingly informing and reshaping the emerging dynamics of design and construction in the built environment of several regions in the Global South.

The conference addresses the following sub-themes: Digital Heritage and Culture, Smart Cities and Buildings, Building Informatics and Parametrics, Digital Media and Generative Art, Virtual Realms and Multiverse Environments, and Performative-Driven Design and Digital Green.

UNIVERSITY OF **PETRA**

كلية العمارة والتصميم
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ASCAAD
ARAB SOCIETY FOR COMPUTATION
in ARCHITECTURE, ART, and DESIGN

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