

A Framework of Media Architecture Elements in Redefining Urban Environments

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Abstract

Media architecture integrates media technology with the built environment, transforming structures into communicative surfaces through digital displays, interactive installations, and dynamic lighting. Despite its innovative nature, research on media architecture's impact on human behaviour and urban experiences remains limited. Lacking unified design principles, this study aims to identify key elements of media architecture and assess their influence on user experience. The study recognizes the absence of standardization and regulations and thus explores how identified elements can lead to innovative, functional designs integrating digital media with physical environments. Proposed conceptual framework was initially tested through case studies of two internationally recognized buildings. Addressing the limited research on media architecture within Malaysia, the framework was then applied to Pavilion Kuala Lumpur. Findings reveal the framework's utility in assessing the integration of built form and digital information, the socio-spatial impact of media architecture, and the balance between commercial and community-oriented content. The study underscores the importance of harmonizing design with context to promote engagement and enrich urban experiences.

Keywords:

Media Architecture, Media Architectural Qualities, Media Displays, User Experience, Urban Environment

Article History

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1. INTRODUCTION

Architecture is influenced by the rapid development of science in a variety of fields. In each period of technological advancement, this influence can be seen in the development of various architectures typology. In each location, type of architectural style is a representation of a distinct culture. The uniqueness of a building's architecture is a reason to travel. In the world, the advancement of science coincides with the advancement of architecture. The shape and colour of architecture have also changed as science has progressed, as can be seen from the architecture's overall physique (Pane. I. F). According to Vitruvius in (Vitruvius, 1914), architecture is made up of three parts: *venustas*, *firmitas*, and *utilitas*. These are frequently referred to as beauty, utility, and durability. As indicated by him, design should be sturdy and ready to endure everyday hardship.

Media architecture not only attracts people and engages them in public spaces but also enhances social relationships and collective action at the local level. The use of digital displays, interactive installations, and urban screens has transformed many urban areas into vibrant hubs of activity, fostering a sense of community and shared experience among residents and visitors alike. For instance, the concept of "urban screens" has been explored extensively by researchers like Scott McQuire, who discusses how these screens can serve as platforms for public art and community engagement (McQuire, 2008). Supporting this statement, (Urbanowicz & Luctna, 2016) highlight that the primary goals of media architecture include activating public spaces, engaging communities, fostering connections between disparate urban areas, and showcasing the distinctiveness of locations. These objectives underscore the profound influence of social factors on the perception and utilization of media architecture, as further emphasized by (Hespanhol & Dalsgaard, 2018).

The field of media architecture is still evolving, with limited comprehensive definitions available. One notable definition comes from (Martin Brynskov et al., 2013) , who describe it as an overarching concept that involves designing physical spaces on an architectural scale, incorporating materials with dynamic properties to enable dynamic, reactive, or interactive behavior. (Zielinska-Dabkowska, 2014) highlights the lack of regulations and guidelines for aspects like brightness, motion, and color use in media architecture within urban spaces. Public spaces have historically served as flexible areas for community gatherings across various cultural and social events. There is a recognized need for a common language and framework to guide the design of media architecture, ensuring it is contextually responsive, engaging, and effective, as emphasized by (Tomitsch, 2018).

This research aims to address the identified gaps by developing a comprehensive framework that integrates insights from various disciplines, including architecture, urban planning, sociology, and environmental science. The framework will provide a structured approach to understanding how media architecture can be used to create more inclusive and vibrant urban environments. By emphasizing social equity, this research will contribute to the development of media architecture that not only enhances urban aesthetics but also promotes inclusive community engagement. The proposed framework will explore the key elements of media architecture and their role in redefining urban environments, addressing the social challenges associated with their implementation. Case studies are included in this study to analyze user perceptions, guiding policymakers to create vibrant environments through enhanced urban livability and engagement.

Hence, media architecture offers a powerful tool for transforming urban environments by combining technology, art, and design to create engaging and interactive public spaces. As this field continues to evolve, it is crucial to develop a comprehensive framework that outlines the key elements and considerations for integrating media architecture into urban planning. This framework will not only enhance the aesthetic appeal and social cohesion of cities but also contribute to their economic vitality and sustainability.

2. LITERATURE REVIEW

2.1 Terminologies

Since this is a relatively new discipline, many definitions related to the use of artificial light in urban contexts, including media architecture, do not fully capture the terms' meanings as cited in the literature. There is a need to standardize terminology and explain the subject more comprehensively to better illustrate the phenomenon, as there is a limited amount of published theoretical research. The definitions presented in the following tables are compiled interpretations from various published authors who have conducted theoretical research in this field (Zielinska-Dabkowska, 2014).

Table 1: Interpretations of definitions from various published authors

Media architecture	A building's exterior skin that features a "curtain wall" of LED light panels (Scully) in which dynamic graphics, text, images, and spatial movement are projected on built-environment elements, typically on buildings and architectural structures in public areas
Media facades	Digitally controlled lighting illuminates' exteriors which is also frequently associated with illuminated advertising and vivified screens with too many dimensions.
Artificial facade lighting	Façade lighting refers to the intentional usage of artificial illumination on a building's external surfaces to improve its appearance and attain functional prerequisite at night.

Source: Foth & Caldwell, 2014; Herr, 2012; Scully; Zielinska-Dabkowska, 2014

2.2 Growth Factors of Media Architecture

As outlined by (Ptichnikova & Anytufeev, 2019), four key factors have been identified as influencing the development and assessment of media architecture, as follows:

Table 2: Growth factors of Media Architecture

Technical turn	Refers to a major shift in scientific ideas and approaches driven by technological advancements that have transformed architectural practices.
Medial turn	Involves integrating media into urban spaces to create new possibilities for organizing and interacting with environments.
Visual turn	Emphasizes the dominance of visual perception in understanding reality, making visual culture a central element in media architecture.
Mass culture	Spreads spiritual and material values to broad segments of society, influencing mass consumers and shaping public spaces.

Source: Ptichnikova & Anytufeev, 2019

2.3 Media Architectural Qualities

Media architecture focuses primarily on visual perception, aiming to simplify and clarify information for the audience (Wiethoff et al., 2014). The distinctiveness of contemporary media engineering lies in its ability to create new forms of communication and influence human consciousness, as well as in producing a qualitatively new hybrid urban environment. This environment offers a perception of actual reality while involving participation in the construction of an artificial virtual reality (Ptichnikova & Anytufeev, 2019). According to (Berrett, 2018), design concepts for digital media content in media architecture should convey a deeper narrative. He derives three design recommendations from five key qualities—story, narrative, visual, audio, and interaction. These recommendations are intended to serve as scaffolds in the specified order and can also be used to assess audience comprehension and engagement. These design recommendations impact the qualities of media

architecture, which are categorized as physical, experiential, and communicative, as outlined by (Houben et al., 2017) in the following diagram.

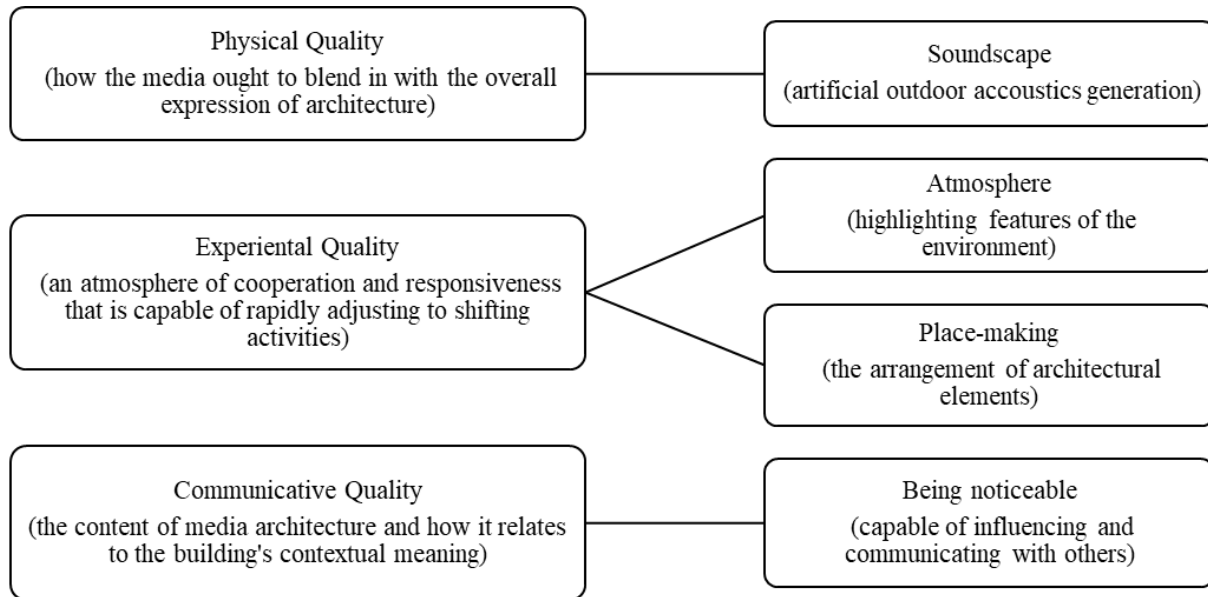


Figure 1: Media architectural qualities

Source: Houben et al., 2017

Given the absence of definitive key aspects in designing media architecture, a systematic approach called the Design Space Explorer for media facades, adapted from Brynskov (2009) and Dalsgaard et al. (2008), is employed. This approach aids in gaining an overview of the design space, conceptualizing important aspects of interaction design, and facilitating communication with users. Several elements that need to be considered are listed in Table 4 and Table 5, along with examples provided by Dalsgaard et al. (2008).

Table 3 The Design Space Explorer for media facades

Material	Form	Location	Situation	Interaction	Content	Purpose	Experience
LED	Matrix	Corridor	Arrival	Touch	Guidance	Information	Playful
Projection	Line	Wall	Exploration	Gesture	Ornaments	Branding	Solemn

Source: Dalsgaard et al., 2008

Table 4 The Design Space Explorer and related work

	Design Space Explorer	A Pattern Language	User interface pattern	Design pattern	Digital experience	Maps for design reflections	Maps for system development
Domain	Media facades	Architecture	Interfaces	Software	Experience design	Design research	Process management
Purpose	Overview	Solutions	Suggestive	Specific solution	Inspiration	Reflection	Reflection
Structure	High	High	High	Medium	Low	High	High
Content	Low	Rich	Rich	Rich	Rich	Minor	Minor

Source: Dalsgaard et al., 2008

As noted by (Halskov & Ebsen, 2013), various elements of media display include scale, shape, pixel configuration, pixel shape, and light quality. Understanding scale is crucial for perceiving the size and volume of a building. Representations such as drawings, models, and simulations are often scaled

down, making it difficult to fully appreciate the true dimensions of the media facade. Shape refers not only to the outer boundaries of the media screen but also to the contours of the image surface itself. While conventional displays are mostly flat and rectangular, media facades can adopt a variety of shapes, sometimes extending around corners, bends, and curves of a building. Pixel configuration, on the other hand, describes how the pixels are arranged on a media facade. This often requires techniques such as sub-pixel sampling to adapt media content from standard digital formats to fit these non-grid configurations.

Pixel shape refers to the actual form of the pixels on the facade. In traditional displays, pixels are typically square and indistinguishable from one another, but on media facades, pixels can take various shapes, influenced by the surrounding architectural elements or lighting fixtures that define the pixel arrangements. This can result in visibility being highly dependent on the viewing angle. Finally, light quality plays a vital role in the accurate display of colors and the brightness of the media facade. The level of brightness determines whether the facade is visible during daylight or only in the evening, and the type of lighting fixture, along with the use of diffusers and reflectors, can create visual effects that differentiate media facades from traditional displays.

Design guidelines for user interfaces often recommend suitable color combinations or "color harmonies," typically focusing on readability or specific elements like text backgrounds. Harmony, in visual terms, refers to an aesthetically pleasing arrangement of elements (J. Ling & Schaik, 2002; R.H. Hall & Hanna, 2004). Lighting, as an ambient factor, also influences non-visual responses such as mood, behavior, and cognitive performance (Ru T de Kort YA et al., 2019; Westland et al., 2017). The interaction between light receptors and the brain's suprachiasmatic nucleus, especially in relation to the blue spectrum, plays a key role in these responses (Ru T de Kort YA et al., 2019). While color and light are intertwined in architectural design and should be considered together in analyzing human mood (Küller et al., 2006), many studies overlook the impact of light sources and the color of visible surfaces, beyond neutral tones (Reza Shahidi et al., 2021).

2.4 Languages of Media Architecture

Architectural theory can be distilled into two fundamental components: "pattern language" and "form language." Pattern language describes how humans interact with buildings, while form language refers to the geometrical formulas used in construction (Scully & Mayze, 2018). Media façades, which are part of media architecture, have become a topic of ethical debate within the architectural community. Initially, they were used primarily for simple displays due to low resolution, but advancements in technology now allow for high-definition visuals (Colangelo, 2014).

Media architecture falls within the pattern language category, as it influences the urban experience by expressing values and potentially inspiring social development (Hill & Vande Moere, 2012). It can extend beyond artistic visuals by integrating localized information into urban screens. The study of media architecture often employs semiotics theory, which interprets signs and their meanings. Semiotics helps architects understand how communication systems intersect with architecture, treating buildings as signs and users as receivers (Pane. I. F). Semiology, a subfield of semiotics focused on visual communication, emerged in the early 19th century and gained prominence through philosophers like Charles Sanders Peirce and Ferdinand de Saussure (Ahmadi, 2012). Scholars such as Umberto Eco have advocated for the use of semiology in the humanities and semiotics in natural sciences (Parsaee et al., 2015). These theories provide a framework for analysing the role of media architecture in urban environments, highlighting its potential to shape social interactions and community engagement.

The following sections depict various models developed by these authors and their implementation in the design of media architecture (Sabounchi et al., 2020).

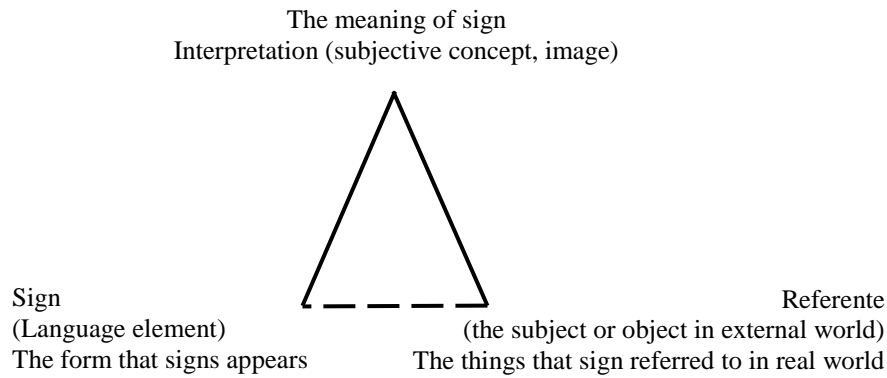


Figure 2: Sign Triangle Based on Pierce Theory (C.S.Pierce, 1867-1893)) and illustrated by (Parsaee et al. 2015)

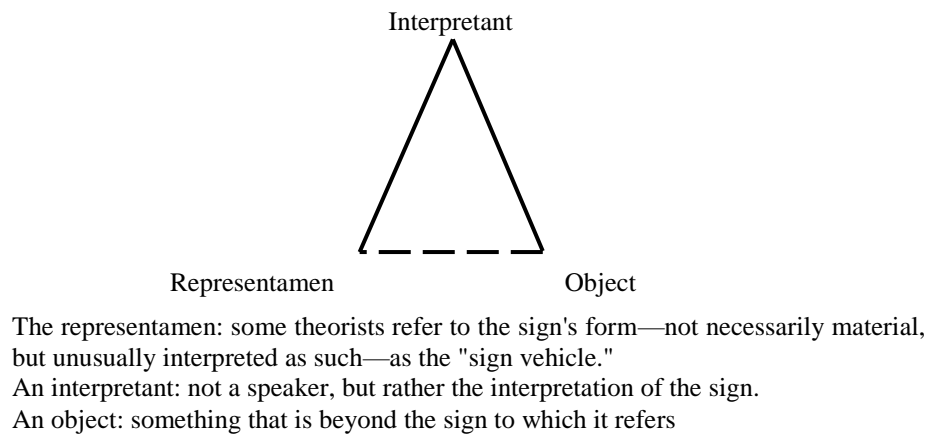


Figure 3: Sign triangle offered by Pierce (C.S.Pierce, 1867-1893) and illustrated by (Parsaee et al., 2015)

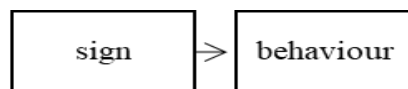


Figure 4: Behaviouristic Model According to Morris
Source: Noth, 1990

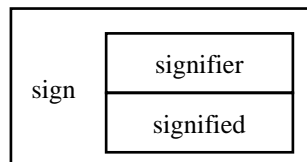


Figure 5: Dyadic Model According to de Saussure
Source: Saussure, 1969

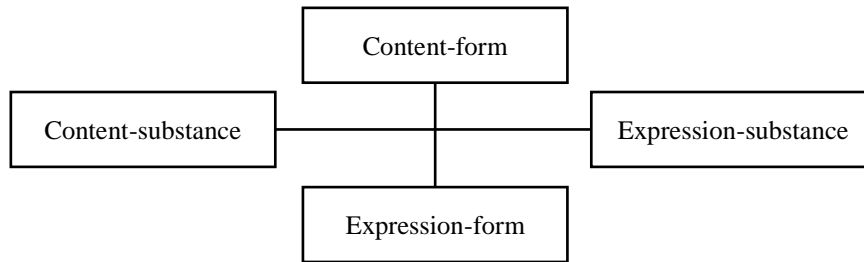


Figure 6: Glossematics model according to Eco
Source: Noth, 1990

The study of semiotics encompasses various models, each offering unique perspectives on how signs convey meaning. The Dyadic Model, developed by Ferdinand de Saussure, focuses on the signifier and signified, highlighting the arbitrary relationship between them. This model provides a foundational understanding of linguistic signs but is limited by its static view of meaning and lack of consideration for the interpreter (Saussure, 1969). In contrast, the Behaviouristic Model by Charles Morris emphasizes pragmatics, integrating behaviourist psychology to explain how signs influence behaviour. While it offers insights into the practical effects of signs, it can be reductionist and oversimplify complex cognitive processes (Morris, 1938).

The Sign Triangle illustrates the indirect relationship between symbols and referents, explaining misunderstandings and acknowledging abstraction in language (Ogden, 1923). However, it is criticized for its simplicity and lack of contextual consideration. Glossematics, developed by Louis Hjelmslev, aims to create a scientific theory of language by focusing on underlying structures. Although it is highly formal and abstract, its complexity and limited practical application are notable drawbacks (Hjelmslev, 1943). These models demonstrate the diversity of semiotic thought, each contributing to our understanding of how signs function in communication.

Table 5: Comparative Analysis of Semiotic Models

Model Component	Key Concepts	Strengths	Limitations	References
Dyadic	Signifier (sound-image), Signified (concept), Arbitrariness, Langue, Parole	Highlights the structural nature of language and the arbitrary relationship between signifier and signified	Ignores the interpreter, static view of meaning, overemphasis on linguistic signs	(Saussure, 1969)
Behaviouristic	Sign Vehicle, Designata, Interpretant, Semantics, Syntactics, Pragmatics	Emphasizes the pragmatic dimension of semiotics (how signs affect behaviour), integrates behaviourist psychology	Reductionist, may oversimplify complex cognitive and cultural processes, limited scope	(Morris, 1938)
Sign triangle	Symbol, Thought/Reference, Referent, Indirect Reference	Illustrates the indirect relationship between symbol and referent, explains misunderstandings, acknowledges abstraction in language	Simplicity, lacks context, limited accounting for social, cultural, and historical factors	(Ogden, 1923)

Glossematics	Expression and Content (Form and Substance), Expression Form, Expression Substance, Content Form, Content Substance, Paradigmatic Relations, Syntagmatic Relations	Highly formal and abstract, aims to develop a scientific theory of language, focuses on underlying structures	Abstraction, complexity, limited practical application, challenging terminology	(Hjelmslev, 1943)
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The study of recent "media-architecture" projects requires knowledge of technologies and methods that are vastly different from one another and cannot be easily categorized into predetermined groups. This new construction technology necessitates the use of terminology from fields such as electronics, computer science, chemistry, and the physics of nanomaterials. Analyses of media-architecture projects completed in the last quarter of the 20th century reveal a gradual shift from traditional building technologies to electronic technologies (used to create architectural projections) and an ongoing trend towards embedded system integration. The relationship of media architecture to the landscape has also evolved: buildings are now becoming digital landmarks within both natural and urban settings (Gasparini, 2014). Figure 9 illustrates the classifications of media architecture's relationships with various factors, as detailed by Gasparini (2014).

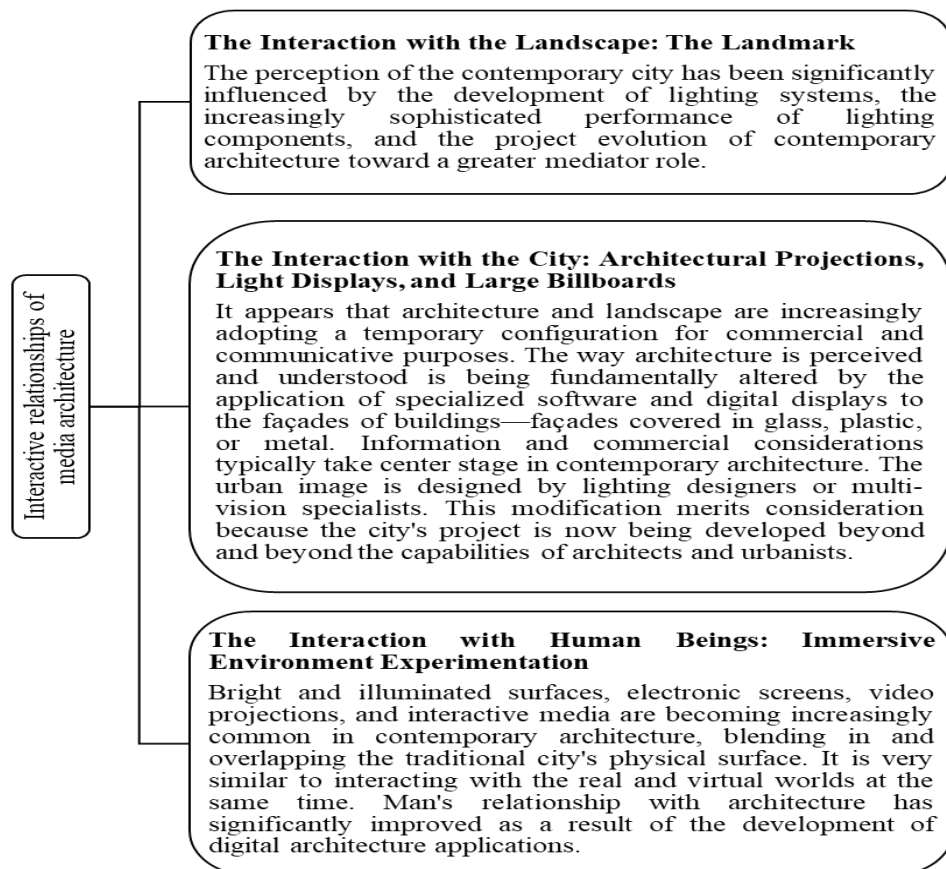


Figure 7: Interactive Relationships of Media Architecture
 Source: Dalsgaard & Halskov, 2010; Foth & Caldwell, 2014; Gasparini, 2014

3. METHODOLOGY

3.1 Data Collection

The research employed a systematic review of multidisciplinary journal articles to investigate media architecture. An initial search of databases like SCOPUS and Google Scholar yielded 983 articles, which were refined through a multi-stage screening process. This process involved removing duplicates, assessing relevance based on titles and abstracts, and conducting detailed content analysis as shown in Figure 8. Ultimately, 128 articles were selected for in-depth review, focusing on key factors influencing media architectural qualities in urban environments.

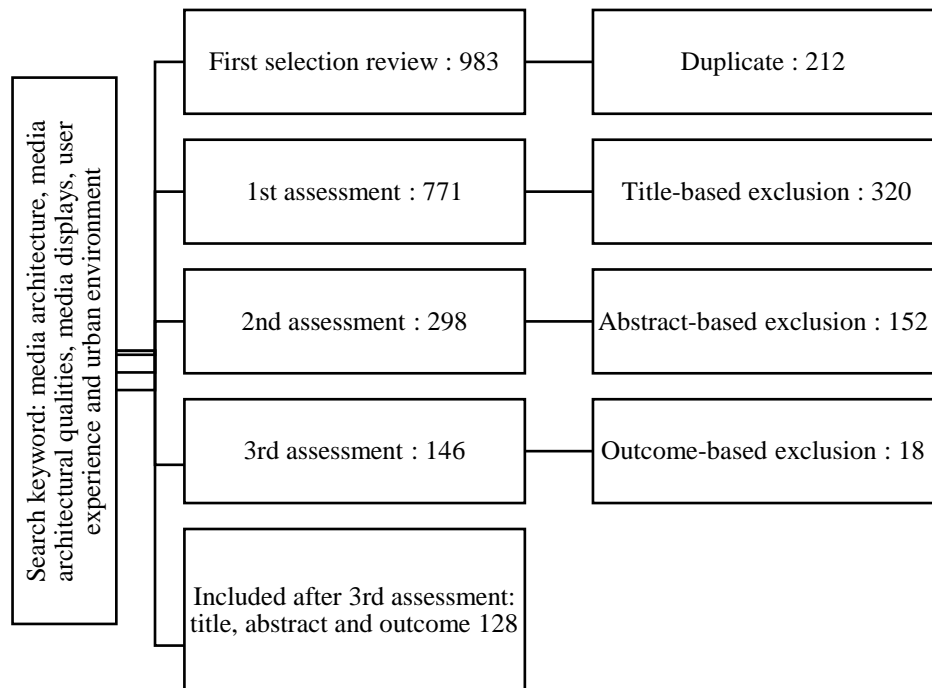


Figure 8: Flowchart Illustrating the Process of Screening and Reviewing to Select Relevant Sample Articles

The review process revealed a gap in existing research concerning design attributes within media architecture, as illustrated in the attached diagram. Figure 9 identifies six categories of findings such as design factors, impacts/perceptions, interactivity/integrations, purpose, technologies, and others, the analysis pinpointed a need for greater exploration of visual and structural aspects. To address this gap, the study aims to identify critical design factors for media architecture in urban contexts, culminating in a conceptual framework that harmonizes aesthetic, practical, and technological considerations. This framework will inform future design practices, ensuring a more integrated approach to media architecture in the built environment.

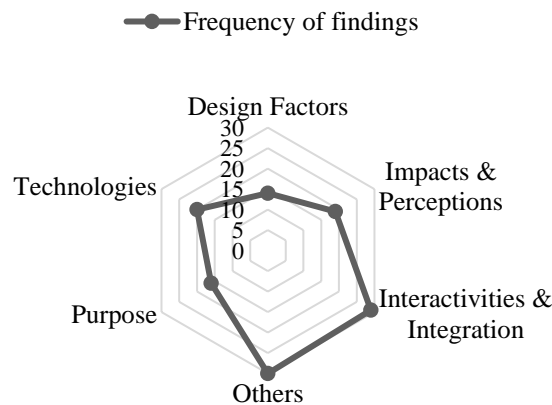


Figure 9: Categories of Media Architecture Findings Based on Frequencies of 128 Articles

4. RESULTS AND ANALYSIS

4.1 Conceptual Framework

Based on the literature review, this research employs a comprehensive framework to analyze user experiences with media architecture that is structured around expression and content, each with form and substance dimensions and drawing on semiotic theory, the framework treats media architecture as a sign comprised of a signifier (building expression using media displays) and a signified (the content affecting the surrounding environment), which influences user experiences through a technological advancements. The Expression analyzes how the building integrates media (Form) using elements such as the scale, size, illumination, and sound (Substance) while the Content considers the concept of planning (Form) through interactions with the landscape, human beings, and the city, alongside the ideology of the media architecture (Substance) by analyzing its intended message or function. By understanding these components, designers, policymakers, and urban planners can leverage media architecture to enhance urban environments for the demographic segment with an emphasis on youths and young adults, fostering inclusive, vibrant, and sustainable urban spaces.

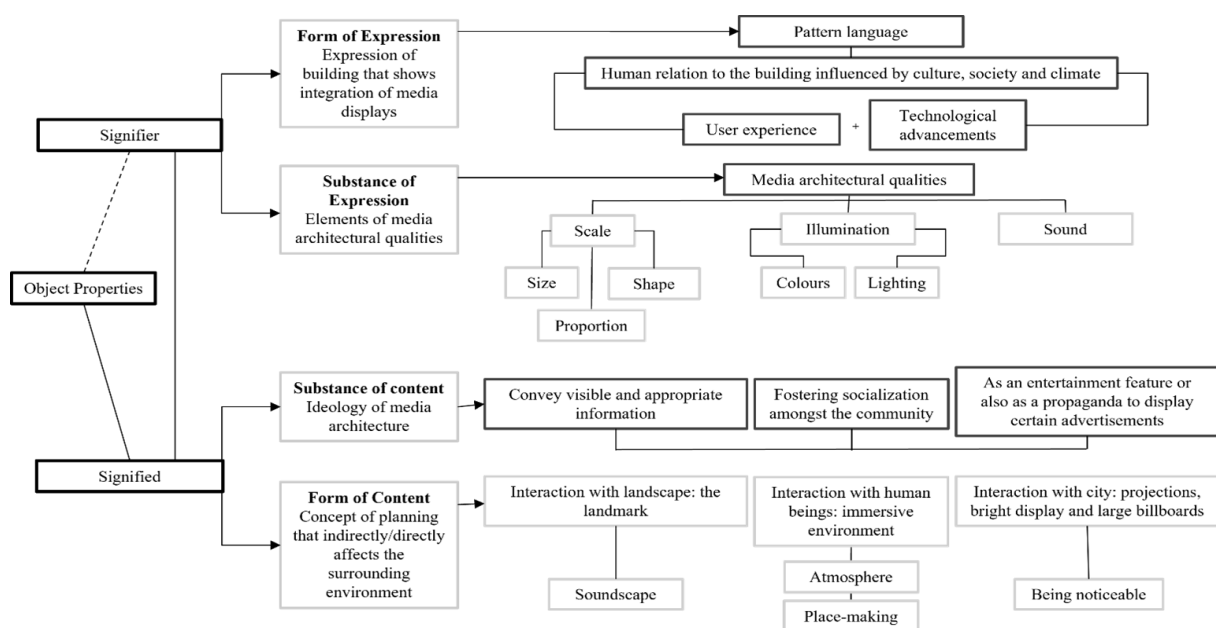


Figure 10: A Conceptual Framework of Media Architectural Elements

4.2 Case Studies Analysis

The conceptual framework (Figure 10) is validated through an examination of the media architectural characteristics of two prominent international buildings. Acknowledging the scarcity of research on this topic within Malaysia, this study then adapts the framework for application to Pavilion Kuala Lumpur, offering a novel contribution to the understanding of media architecture in a Malaysian setting.

4.2.1 Case Study A: Times Square, New York City

Based on the proposed framework (Figure 10), Times Square in New York City serves as a prime example of media architecture, functioning as both a signifier and a signified within its urban context. The form of expression is characterized by the integration of massive digital displays into building facades, showcasing technological advancements in LED technology. The substance of expression encompasses measurable parameters such as scale, with displays dominating building surfaces, creating an overwhelmingly visual environment. Vibrant colors and high-intensity lighting contribute to its sensory-rich atmosphere.



Figure 11: Media Architecture at Times Square, New York City

In terms of form of content, Times Square's media architecture transforms the area into a global landmark, creating an immersive experience through its dynamic atmosphere and place-making. It interacts intensely with the city through bright displays and large billboards, contributing to its distinctive character. The substance of content conveys visible information, primarily commercial advertising, while also serving as a backdrop for public gatherings (Garcia, 2014). Consequently, Times Square functions as a space that blends entertainment with commercialism, fostering a unique yet potentially alienating environment (Davis, 2017).

4.2.2 Case Study B: Shibuya Crossroads, Tokyo

Shibuya Crossroads in Tokyo, renowned for its organized chaos of pedestrian traffic, exemplifies media architecture through its dynamic integration of large-scale digital displays. Applying the framework, the form of expression is characterized by the concentration of massive LED screens on surrounding buildings, strategically positioned to capture the attention of the bustling crowds. The substance of expression is defined by the sheer scale and number of displays, creating an immersive visual environment. The vibrant colours, high-intensity lighting, and synchronized sound create a sensory overload, enhancing the area's energetic atmosphere (Brown, 2020).



Figure 12: Media Architecture at Shibuya Crossroads, Tokyo

In terms of form of content, Shibuya Crossing leverages media architecture to reinforce its status as a global icon of Tokyo, symbolizing modernity and urban vibrancy. The displays contribute to place-making by creating a memorable and visually stimulating experience for pedestrians. The substance of content primarily conveys commercial advertising, entertainment promotions, and public service announcements, contributing to a dynamic yet commercially driven urban space. While fostering a sense of excitement and visual spectacle, the environment primarily caters to consumerism and spectacle rather than deeper social engagement (Garcia, 2018).

4.2.3 Case Study C: Pavilion Bukit Bintang, Kuala Lumpur

The form of expression manifests in the integration of large-scale LED screens, digital billboards, and dynamic lighting systems on the building's facade and within its interior. In line with the framework's substance of expression, the measurable parameters are assessed. The scale of the primary LED screen fronting Bukit Bintang is a key consideration, influencing visibility and impact. Furthermore, the size and shape of digital displays, ranging from conventional rectangular billboards to architecturally integrated curved LED panels, demonstrate varied applications. Illumination, encompassing vibrant colours and carefully orchestrated lighting, contributes significantly to the ambiance, particularly during evening hours.

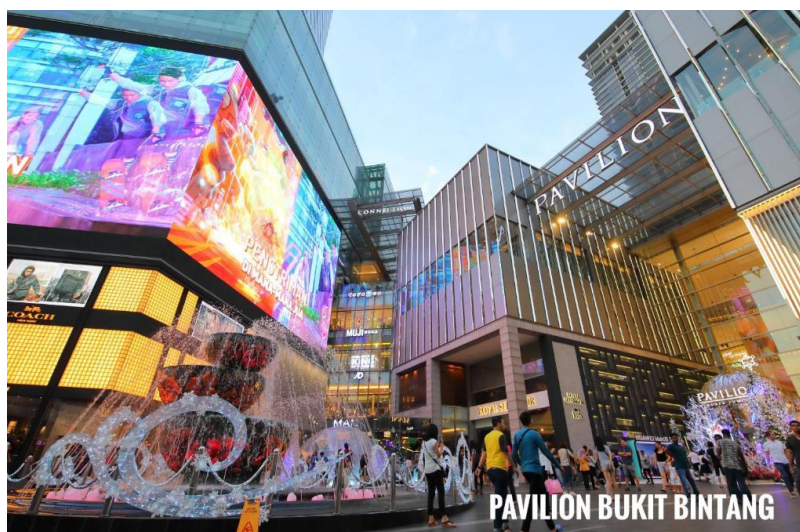


Figure 13: Media Architecture at Pavilion Bukit Bintang, Kuala Lumpur

Within the framework's form of content, Pavilion Kuala Lumpur's media architecture serves to reinforce its position as a prominent landmark and commercial destination. The creation of an immersive environment fosters interaction with human beings, enhancing the shopping experience and contributing to place-making. The interaction with the city is evident in the displays' high visibility, contributing to Bukit Bintang's identity as a vibrant commercial district. Regarding the substance of content, the media architecture primarily functions to convey visible information in the form of commercial advertisements and promotional material. While providing a backdrop for public events, potentially fostering socialization amongst the community, the dominant function aligns with the use of media architecture as an entertainment feature and a vehicle for commercial messaging.

5. DISCUSSIONS AND CONCLUSION

The systematic application of the proposed conceptual framework (Figure 10) across diverse case studies provides a valuable methodology for understanding media architecture, particularly concerning its impact on youth and young adults. By analyzing both the Object Properties (the Signifier), encompassing the Form of Expression (integration of media) and the Substance of Expression (scale, illumination, and sound), and the resultant Signified Properties, the framework facilitates a nuanced understanding of how media integration affects the urban experience. Analysis considers how architecture shapes socio-spatial dynamics by the Form of Content, including interaction with the landscape and human beings, and its relation to aspects such as atmosphere and place-making, and whether the project effectively balances commercial goals (entertainment/propaganda) with community values by the Substance of Content, like fostering socialization.

Future research should refine this framework, exploring its applicability across diverse contexts and integrating considerations of pattern language, human relations influenced by culture, user experience, and technological advancements. This research ultimately aims to ensure that media architecture enhances urban environments, improving the lives of young urban dwellers. Besides, for users, it means more immersive, dynamic environments where buildings are not just static structures but interactive spaces that engage through light, sound, and visual media. This can enhance their emotional and sensory experiences in public spaces, making cities and landmarks more engaging and memorable. The framework's emphasis on user experience ensures that the design considers accessibility, inclusivity, and cultural relevance.

Users benefit from buildings that are not only visually appealing but also foster social interaction and community engagement. Whether through media displays that convey information, serve entertainment purposes, or promote public art, users become active participants in these spaces. Ultimately, this approach transforms buildings into more than just functional spaces, offering enriching, interactive experiences that align with the needs and behaviours of modern urban dwellers.

6. RECOMMENDATIONS

Future research should refine the proposed framework, assessing its applicability across diverse contexts to ensure media architecture enriches, rather than overwhelms, the human experience. Additionally, integrating technologies like AR, VR, and AI holds promise for dynamic, personalized interactions between users and buildings. Further investigation is needed to understand how these tools transform public spaces and enhance architectural storytelling. Technical challenges surrounding these integrations, like power consumption, data management, and interface design, warrant exploration to guarantee seamless, user-friendly environments.

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