

From Participatory Public Art to Urban System Media: The Development Trajectory, Spatial Logic, and Architectural Significance of Interactive Urban Installations

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Abstract: *Interactive urban installations have emerged as a significant design strategy for intervening in public space, with their spatial influence expanding through practices of urban regeneration, public art, and digital urbanism. Existing studies remain dispersed across art history, media technology, and human-computer interaction, leaving a gap in systematic discussion of their logical evolution within architectural discourse and urban spatial production. This paper adopts a narrative review approach to examine the development of interactive urban installations since the 1960s, tracing key phases from participatory public art and media architecture to the playable city and the sentient city, and clarifying shifts in modes of interaction and spatial roles. The study argues that interactive urban installations have evolved from autonomous artistic objects toward spatial interfaces embedded within urban structures. Their central significance lies in reshaping public perceptions of the city and contributing to the formation of social relations in public space. This transformation encourages architecture to move beyond a focus on static form toward an integrated engagement with dynamic processes, interactive relationships, and urban systems.*

Keywords: Interactive urban installations, Public space, Participatory design, Media architecture, Urban interfaces, Architecture.

1. Introduction

With the transformation of public space renewal strategies and the widespread application of digital technologies in urban contexts, interactive urban installations have gradually emerged as a crucial spatial medium connecting public art, architectural design, and urban systems. From early participatory public art practices to contemporary interactive interfaces embedded within urban infrastructure and information networks, these installations intervene in urban life at multiple scales, continuously reshaping the relationship between the public and the built environment. Although such practices have developed rapidly worldwide, theoretical understanding remains fragmented across disciplines. Existing studies tend to focus on art history, new media technology, or human-computer interaction, emphasizing aesthetic expression, technical mechanisms, or functional efficiency. Systematic analyses of their spatial logic evolution and urban significance within architectural and urban research contexts remain limited.

Against the backdrop of contemporary cities shifting from form-and-function orientation toward experience-and process-driven approaches, it is necessary to revisit the developmental trajectory of interactive urban installations. These installations are no longer merely independent artistic interventions; they have gradually evolved into spatial media that mediate relationships among people, environment, and technology. This transformation raises new questions regarding the agency, boundary definition, and design methodology of architectural space.

Based on this perspective, this paper adopts a narrative review approach to qualitatively examine representative theoretical

literature and practical cases since the 1960s, with a focus on the evolution of interaction logics and spatial roles of urban interactive installations across different historical stages. By establishing a phased analytical framework, the study clarifies the transition of interactive urban installations from participatory public art toward systematic urban interfaces, and further explores the implications of this evolution for contemporary architectural and urban design research.

2. Research Method and Review Framework

This paper adopts a narrative review approach to conduct a phased synthesis of theoretical and practical developments in interactive urban installations. Unlike systematic reviews, which emphasize comprehensive literature retrieval and exhaustive coverage, narrative reviews are more suitable for topics with blurred conceptual boundaries and high interdisciplinary dispersion. This approach allows for focused exploration of the historical trajectory, spatial logic, and architectural significance of interactive urban installations. The goal is not to exhaust all existing literature, but to construct an explanatory analytical framework through selective integration of key theories and case studies.

The selection of literature and cases follows the principles of representativeness and theoretical relevance. The theoretical review covers three core phases: participatory art and Situationism from the 1960s to the 1980s; media architecture and responsive environment studies from the 1990s to 2005; and practices since 2005 including tactical urbanism, the playable city, and the sentient city. Case studies are chosen for their exemplary interaction logics, spatial roles, or social impacts, such as *New Babylon*, *The Tower of the Winds*, *Musical Swings*, and various sentient city experiments.

The review analysis is structured around three core dimensions: the evolution of interaction logics, changes in spatial roles, and implications for architectural and urban design. Within a phased analytical framework, the development of interactive urban installations is divided into four stages: conceptual origins, technological intervention, social interaction and domestication, and systematization toward sentient cities. This structure aims to illustrate the transformation of interactive installations from autonomous artistic interventions to embedded components of urban systems, offering an integrated interdisciplinary perspective and providing a theoretical basis for understanding their spatial and social significance in contemporary architecture.

3. Conceptual Origins: Participatory Public Art and the Emergence of Interaction Awareness (1960s–1980s)

The theoretical roots of interactive urban installations can be traced to the social and artistic transformations of the 1960s. During this period, architects and artists increasingly questioned the mechanistic tendencies of modernist functionalist urban planning and began exploring ways to introduce participation into public space, aiming to challenge the rigidity of elite-driven design. The earliest ideas of interactive installations did not originate from technological spectacle or media implementation; they emerged as a medium for social practice and the restructuring of public space. The central concern was who holds authority to shape space and how space, in turn, shapes social relations [1]. This critical awareness gave early interactive installations a pronounced political undertone and experimental social character.

3.1 Situationism and New Babylon: From Production to Play

The concept of the unitary urbanism proposed by the Situationist International in the late 1950s offered significant insight into the early intellectual development of interactive installations [2]. The *New Babylon* project, conceived by Dutch artist Constant Nieuwenhuys between 1956 and 1974, is widely recognized as one of the earliest practical explorations of interactive installations at an urban scale [3]. *New Babylon* was not an abstract utopian vision. Its

conceptual origins can be traced to Constant's 1956 design work for the Alba Gypsy camp, where he systematically observed the spatial practices of nomadic groups, including temporality, variability, and resistance to fixed property. This extracted notion of "mobility" became a core metaphor underpinning the spatial logic of *New Babylon*.

New Babylon aimed to occupy postindustrial leisure time through large-scale, grid-based, open spatial units called "sectors." In Constant's vision, residents, referred to as "homo ludens," could instantaneously reshape the physical and perceptual environment around them, including light, sound, and movable partitions, transforming urban life into a continuous creative game [4].

The interaction logic of this stage emphasized agency and the right to reorganize space: space was no longer a static container but a dynamic environment co-constructed by participants. Interactive installations at this stage carried strong political and utopian implications, aiming not merely for aesthetic experience but for the redistribution of social relations through spatial participation. Through models, sketches, and manifestos, Constant envisioned the city as a labyrinthine structure in constant transformation, where buildings functioned as "screens for the interaction of desire" and public spaces served as experimental grounds for self-expression and social engagement.

3.2 Early Interaction Logic: Bodily Participation and Environmental Reconfiguration

The practice of *New Babylon* revealed key characteristics of early interactive installations in architectural theory: it emphasized participant agency through spatial reconfiguration and foregrounded direct bodily interaction with the environment [5]. This logic was further theorized in the 1958 Amsterdam Declaration, which shifted attention from economic production to symbolic creation and cultural mediation, highlighting the potential of interactive installations as a medium for social transformation. The relationship between space and individuals was no longer unidirectional use or consumption; instead, it became a reciprocal process in which space gained meaning through participation, and individuals enacted social interaction and self-expression through engagement with space.

Table 1: Early Characteristics of Interactive Installations Reflected in Constant's *New Babylon*

Core Dimension	Key Characteristics	Spatial Significance
Subject identity	Homo Ludens	Participants replace passive observers or users
Spatial unit	Sector	A shift from static rooms to dynamic, cross-scale grid networks
Interactive media	Color panels, filters, sound systems	Programmability of environmental atmosphere and spontaneous spatial reconfiguration
Social objective	Elimination of aggression and the aestheticization of everyday life	The dissolution of boundaries between work and life through spatial play

From an architectural perspective, this stage of interactive installations had profound implications for later developments. It inspired architects such as Rem Koolhaas and Bernard Tschumi to explore dynamic spatial configurations and user participation, and laid the conceptual foundation for later discussions on networked spaces, cyber-physical systems, and reconfigurable architecture. This early practice demonstrates that interactive installations were not merely an art form but an initial architectural exploration of dynamic space and

social participation. They integrated technological imagination, social ideals, and spatial practice, providing an intellectual basis for the subsequent emergence of media architecture and digitally interactive environments.

4. Technological Intervention: Mediated Interaction and the Transformation of Urban Perception (1990s to 2005)

With the maturation of computer technologies, sensor systems, and digital control methods in the 1990s, interactive installations moved from early utopian visions into real urban space. During this period, the central concern of interactive installations shifted from the redistribution of social power to the digital enhancement of environmental perception, emphasizing the capacity of space to respond in real time to external physical parameters. Architecture and installations no longer relied solely on bodily participation to enable interaction; they became capable of sensing environmental conditions such as wind speed, noise, and light levels, translating these inputs into visual or audiovisual feedback and forming what came to be understood as responsive environments.

4.1 Toyo Ito and the Tower of the Winds: Visualizing Environmental Energy

Completed in Yokohama in 1986, the Tower of the Winds is widely regarded as a key milestone in the development of media architecture and modern interactive installations [6]. Its significance lies not primarily in visual appearance, but in the complexity of its operational logic. The project is driven by two computer-controlled systems that adjust the lighting patterns of the tower's envelope in real time according to wind speed, noise intensity, and changes in natural light. In this context, architecture does not express a fixed form but operates as a continuously active interface that translates environmental parameters into dynamic light signals [7].

Toyo Ito transformed an existing water tower into a dynamic sensing system. During the day, it appears as an aluminum column, while at night it renders environmental data through light bulbs, neon rings, and spotlights. Physical parameters such as wind speed and noise levels are captured by sensors and mapped onto variations in light, allowing the architectural boundary to gradually dissolve after dark and produce an ambiguous condition between object and environment. The Tower of the Winds represents a clear transition toward the stage of technological intervention, in which interaction no longer depends on direct physical contact but is established through data-driven feedback that creates an invisible connection between space and the city.

4.2 Media Architecture as a Perceptual Amplifier

Interactive installations in this period increasingly exhibited interface-like characteristics, with building envelopes functioning as media for data collection and feedback [8]. Space was no longer understood solely as a physical boundary, but as an entity capable of sensing environmental conditions and human movement, thereby providing the city with new perceptual dimensions. Through light, screens, or sound, media architecture made otherwise invisible urban data perceptible, enabling the public to experience the dynamic processes of the city. Interactive installations gradually shifted from peripheral additions to central elements of architectural narratives, acting as amplifiers of spatial information and anticipating the convergence of building envelopes and urban interfaces.

Table 2: Early Characteristics of Technological Intervention Reflected in Toyo Ito's *Tower of the Winds*

Core Dimension	Key Characteristics	Architectural and Spatial Significance
Interaction type	Responsive	Space senses environmental change and provides immediate feedback, with interaction no longer dependent on direct physical contact
Information flow	Environment to visual / audiovisual expression	Architecture operates as a mediator of environmental data, enhancing urban perception
Technical means	Sensors, LEDs, single-loop control systems	Technology functions as a spatial medium, extending the narrative capacity of architectural envelopes
Role of participants	Environmental perceivers	Human engagement is shaped through the mapping of environmental data, with interaction increasingly dependent on systemic processes

The stage of technological intervention marked a transformation in the spatial logic of interactive installations, moving from bodily participation-driven interaction toward environment perception-driven interaction. Architecture ceased to function as a passive setting and instead became a medium capable of real-time feedback to urban physical phenomena. This shift encouraged architects to rethink the envelope as an interface and laid the groundwork for subsequent developments in social interaction and system-oriented urban interfaces. In this way, interactive installations began to assume a dual role: on one hand, they activated perceptual experiences in public space; on the other, they operated as a bridge between architecture and urban information systems, establishing a continuous logic of perception, feedback, and participation.

5. Human Centered Approaches: Everyday Interaction and the Activation of Public Life (2005 to 2015)

In the early twenty-first century, the development of interactive urban installations underwent a clear shift, moving away from a focus on technological spectacle and

environmental data toward an emphasis on human behavior and social interaction. At this stage, interactive installations increasingly foregrounded the everyday activation of public space and its role as a social mediator. Rather than functioning primarily as responsive systems or visual displays, installations began to promote community engagement, public life, and diverse urban experiences through bodily participation, collaborative mechanisms, and small-scale interventions.

5.1 Micro-Interventions in Tactical Urbanism

Tactical urbanism advocates short-term, low-cost, and scalable interventions as a way to test possibilities for urban transformation. Within this context, interactive installations operate as flexible experimental modules that stimulate public participation by altering the physical conditions of space. Typical examples include the installation of interactive seating in underused parking spaces or the suspension of sensor-based lanterns above streets, encouraging pedestrians to pause and interact in unexpected ways along their daily routes. Such micro-interventions resonate with Henri Lefebvre's concept of lived space, in which citizens

temporarily resist rigid spatial orders shaped by capital and administrative power through participatory action, enabling spontaneous reconfiguration of public space.

5.2 The Playable City and the Deepening of Interaction Concepts: Interaction as Dialogue Rather than Reaction

The playable city movement emphasizes the integration of digital technologies and spatial design to enhance urban playfulness and social interaction, rather than prioritizing efficiency or surveillance as in many smart city models. The project *21 Swings* by the Canadian design studio Daily tous les jours is a representative example. While each swing individually produces a reactive response to a single action, the system as a whole requires multiple participants to coordinate their rhythms in order to generate a complete melody [9]. Through the translation of physical movement into sound feedback, the installation enables collaborative interaction and the formation of social mechanisms,

transforming previously detached public space into a social node.

During this period, Usman Haque, drawing on the cybernetic theories of Gordon Pask, clearly distinguished between reactive and interactive systems. He argued that many so-called interactive installations function as single-loop reactive systems, such as automatic doors, whereas genuine interaction should be understood as a multi-loop system in which humans and environments engage in continuous and evolving information exchange resembling a dialogue [10]. In experiments such as the *Reconfigurable House*, Haque demonstrated that meaningful interaction allows participants not only to influence outputs but also to modify the rules by which inputs are processed, enabling dynamic dialogue. This perspective highlights the potential of interactive installations as social mediators: rather than merely offering playful experiences, they strengthen social sustainability and residents' sense of participation in public space through collaborative structures.

Table 3: Characteristics of Interactive Installations from 2005 to 2015

Core Dimension	Key Characteristics	Architectural and Spatial Significance
Interaction type	Social	People establish collaborative interaction through installations, positioning public space as a social medium
Information flow	Person to person (mediated by the installation)	Participants' actions influence one another, turning space into a platform for cooperation and communication
Technical means	Mobile internet, collaborative algorithms, sensors	The integration of digital and physical systems enhances playfulness and participation
Role of participants	Co-creators	Citizens shift from passive observers to active participants in shaping spatial behavior and rules

This stage marks a deepening of the spatial logic of interactive installations, shifting from environment-responsive systems toward design practices centered on interpersonal interaction and everyday behavior. Architecture and public space increasingly came to be understood as collaborative platforms that activate social practices through both physical and digital media, enhancing community cohesion and spatial vitality. The empowering role of interactive installations at the social level became particularly evident, positioning them not as aesthetic additions but as key contributors to the sustainability of public space and to processes of social participation.

6. Systemic Shift: From Interactive Installations to Urban Interfaces (2015 to the Present)

Over the past decade, with the widespread adoption of artificial intelligence, the Internet of Things, big data, and edge computing, interactive urban installations have undergone a profound systemic shift [11]. They no longer exist as independent physical objects or isolated spatial interventions, but are increasingly embedded within urban infrastructure and information networks, functioning as perceptual nodes and operational interfaces of urban systems. At this stage, interaction extends beyond individual or collective behavior to encompass urban processes themselves, as interactive installations begin to participate in the sensing, feedback, and regulation of urban metabolism.

6.1 The Sentient City and the Spatialization of Real-Time Data

Research conducted by the MIT Senseable City Lab is representative of this phase. The concept of the real-time city emphasizes that urban space is now covered by dense information networks, and that the role of interactive installations lies in revealing and visualizing data processes that are otherwise imperceptible. The Trash Track project is not merely an exercise in data visualization; rather, it exposes long-obscured inefficiencies and inequalities within urban resource chains. By using tracking technologies to follow the movement of waste through urban systems, infrastructural operations are transformed into spatial narratives that can be understood by the public. Although such projects may not always take the form of explicit physical installations, they construct new dimensions of interaction at the level of digital interfaces and spatial perception.

At more tangible spatial scales, smart streetlights and interactive street facilities have become typical examples. These elements no longer serve only lighting or circulation functions, but are able to sense air quality, pedestrian density, and climatic conditions, and adjust their states accordingly. Interactive installations are thus redefined as terminal nodes within an urban neural network, taking on combined roles of information collection, feedback, and localized regulation.

6.2 From Public Installations to Urban Interfaces

A defining characteristic of the systemic stage is the deep integration of interactive installations with architectural components and urban infrastructure. Installations are no longer treated as objects added to space, but evolve into urban interfaces that are simultaneously components of physical space and points of access to digital systems. Building facades,

ground surfaces, transportation nodes, and public furniture increasingly become sites of information exchange and interaction, allowing the interface to be understood as a spatial quality rather than a discrete technical element.

This shift fundamentally alters the role of architecture. Buildings no longer function solely as static backgrounds for activities, but participate in the real-time generation and modulation of space through sensing and algorithmic processes. In this context, interactive installations operate as mediators between atoms and bits, enabling continuity between physical environments and digital systems [12].

6.3 Interactive Installations from an Actor-Network Perspective

Within this systemic transformation, Actor-Network Theory offers an important ontological framework for understanding interactive installations. From this perspective, human and non-human actors possess comparable forms of agency within networks. Sensors, algorithms, and interactive installations are therefore no longer passive tools, but active participants in the production of urban meaning. By translating social relations and data flows, interactive installations reshape spatial practices and power structures.

Table 4: Key Characteristics of the Systemic Shift Phase

Core Dimension	Key Characteristics	Architectural and Spatial Significance
Interaction type	Systemic / AI	Space participates in urban operational processes, with interaction extending to the system level
Information flow	System to environment / people	Architecture functions as a node within data networks, enabling spatial regulation and feedback
Technical means	Artificial intelligence, Internet of Things, edge computing	Technology is deeply embedded within spatial components, making the interface an integral part of architecture
Role of participants	Network nodes and co-acting agents	Human and non-human actors jointly shape urban behavior through interconnected systems

The systemic stage marks the completion of the transition of interactive urban installations from localized interventions to urban media. This shift positions interactive installations as a critical lens through which to understand the contemporary city. Architecture and public space are no longer merely sites where interaction occurs, but integral components of interactive systems themselves. This transformation not only changes how space is perceived, but also prompts architecture to reconsider its position within highly data-driven urban environments. Architects increasingly assume the role of system integrators and designers of relationships, and are required to negotiate a balance between spatial form, technological logic, and social ethics.

7. Discussion: The Spatial Repositioning of Interactive Urban Installations

A review of the conceptual origins, technological intervention, human-centered turn, and systemic phase of interactive urban installations reveals that their evolution has not been driven solely by technological advancement; rather, it is closely tied to changes in modes of urban spatial production and shifting conceptions of publicness. The role of interactive installations

has gradually moved from artistic expression or technical display toward that of a key medium participating in the formation of urban spatial structures and social relations.

At the spatial level, interactive installations have continuously moved beyond the status of auxiliary elements and become embedded within architectural components and urban infrastructure, forming urban interfaces capable of sensing and feedback. This process has encouraged architecture to shift away from a focus on stable form toward an engagement with dynamic processes, information flows, and event generation. Interaction is no longer understood as an activity occurring within space, but as an intrinsic property of space itself.

At the social level, interactive installations increasingly assume a mediating role in public life. Through collaborative mechanisms, playful design, and system feedback, they are able to activate weak social ties within public space, fostering brief encounters between strangers and the formation of shared social recognition. This capacity distinguishes interactive installations from conventional public art or urban furniture, positioning them as spatial tools with the potential to regulate social relations.

Table 5: Interaction Evolution Matrix

Period	Interaction Type	Information Flow	Key Technologies	Participant Role
1960s	Participatory	Human to physical reconfiguration	Mechanical systems, manual control	Holder of spatial agency
1990s	Responsive	Environment to visual expression	Sensors, LEDs, single-loop control systems	Environmental perceiver
2010s	Socially Mediated	Human to human (mediated by installations)	Mobile internet, collaborative algorithms	Co-creator
2020s	Systemic/AI-driven	System to environment / people	Artificial intelligence, edge computing, Internet of Things	Network node and sensor

The spatial repositioning of interactive urban installations ultimately reflects a broader shift in the role of architecture within the digital city, from a shaper of form to an organizer of relationships and a mediator of systems. At the same time, the systemic phase also reveals emerging tensions. As interactive installations become deeply integrated with data systems, public space faces the risk of excessive sensing and governance. While such installations can enhance efficiency

and experience, they may also reinforce logics of surveillance and reduce openness and anonymity in public space. Future interactive design therefore requires not only technological innovation, but also active architectural engagement with ethical and governance frameworks, in order to balance participation, the possibility of withdrawal, and data transparency.

8. Conclusions

Through a narrative review approach, this paper has systematically examined the development of interactive urban installations since the mid-twentieth century, outlining their phased evolution from conceptual experimentation and technological intervention to human-centered practices and, more recently, to systemic urban interfaces. The findings indicate that the core value of interactive urban installations does not lie in technology itself, but in their capacity to reshape urban modes of perception, structures of public interaction, and logics of spatial production.

In the contemporary context, interactive installations are no longer independent design objects, but function as key media embedded within urban systems, participating in the co-production of urban operations, public life, and social relations. This shift places new demands on architecture. Rather than responding only to the physical environment, architecture must now address the intersection of information systems, social behavior, and ethical considerations.

Future research may further explore interactive urban installations from perspectives such as multispecies approaches, spatial equity, and low-technology interaction strategies, in order to examine their adaptability and limitations across different urban contexts. By situating interactive installations within the core discourse of architectural and urban theory, it becomes possible to expand both the theoretical depth and practical potential of architecture in increasingly mediated urban environments.

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