

## Conference Paper

# Interactive Architecture-Interdisciplinary Design Pedagogy in Shenzhen University

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## Abstract

Interactive architecture is deemed as a real-time narrative medium, able to reconnect and renew the relationships between participants (users) and the surroundings to help them explore their own motivations, inspirations, decisions, and outcomes. The sensor-based, human-computer (machine) integrated architecture can transform and uplift people's daily life in entirely new ways, by strategically unlocking the potentials that technological innovations bring.

This paper intends to provide a platform for further research and experimentation in the realm of interactive architecture, to encourage rethinking of the relationship between human desires and responsive space (physical or intangible) through a brief introduction to interactive architecture, and to explain the original interdisciplinary teaching methods utilized in the thesis project. By reviewing conceptual and practical cases and related theories, the readers can have a primary understanding of the particular subject and may also change their way of thinking and doing architecture. As interactive architecture is still in its beginning stage, many explorations and related methodologies need to be put in a theoretical framework. Therefore, the author of this paper strongly suggests formulating a comprehensive framework in order to guide the future generation of architects for sustainable urban development.

**Keywords:** Interactive Architecture, public space, public engagement, interdisciplinary design pedagogy, art performance, mechanical engineering

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## 1. Introduction

Interactive architecture is defined as spaces and objects that can physically re-configure themselves to meet changing needs. (Fox, Michael, and Catherine Hu.(2005) "Starting from the Micro: a Pedagogical Approach to Designing Interactive Architecture." In Smart Architecture: Integration of Digital and Building Technologies: Proceedings of the 2005 Annual Conference of the Association for Computer Aided Design in Architecture, 78-93. ACADIA. Savannah, Georgia: Savannah School of Architecture and Design (SCAD)) Different from static permanent architecture in the conventional sense, "interaction" in architecture refers to the feature of real-time and the dynamic nature of it. By acting as a real-time narrative medium, interactive architecture is able to reconnect and

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renew relationships between participants (users) and their surroundings to help them explore their own motivations, inspirations, decisions, and outcomes. (Lehman, M, L. (2017) *Adaptive Sensory Environments*. London: Routledge) This kind of sensor-based, human-computer (machine) integrated architecture can transform and uplift people's daily life in entirely new ways, by strategically unlocking the potentials that technological innovations bring. In that case, people were introduced to a dynamic, intelligent, and responsive environment. Notably, the application of interactive architecture can only be achieved by digital technologies, mechanical engineering, and behavioral sciences integrated to realize interactivity which certainly leads to a boundary crossing working approach. This year for the thesis project, the students were supposed to address the issue of "interactive architecture", exploring the interactive performance of architecture or installation in urban spaces with the engagement of public. As for interdisciplinary work, mechanical engineers have participated in the team as technical consultants, collaborating with the teacher and students to bring artistic creation into reality. Since the "interactivity" in architectural realm is just an embryonic topic which hasn't become a concern in mainstream architecture discourse in China, it is necessary to outline this new approach to architecture research& practice, utilizing new technologies in the background of cyberculture era. The discussion is raised among young scholars, researchers, students, engineers and other practitioners, to extend their work beyond built environment to a long-term urban development strategy. The ultimate goal of this attempt is to help formulating the theoretical framework of interactive architecture in an accessible way to guide architects for future practice.

Yet the aesthetic context of interactive architecture remains the focal point in the methodology. As a result of technological contribution, most of the documented papers about interactive architecture were placing emphasis and detailing on technological solutions such as aided software system instead of human motivation and art performance. The potential of different disciplines impacted each other has been neglected through the years as the interdisciplinary methodology is largely unexplored. Therefore, it is still necessary to cover further disciplines such as performing arts and social-anthropology to study human mindsets, behaviors and choices in response to dynamic space creation. In addition, this paper will briefly introduce the collaborative team of multiple participants (teacher/student/mechanical engineer) as well as the "collaborative learning" method to expect innovative design outcome on the particular subject.

## 2. Background

In terms of “interaction”, there are psychological, physical and sociological explanations. “Interaction” in an architectural sense is usually associated with the notion of “adaptive”, “flexible”, and “responsive”. (虞刚. (2017) 走向互动建筑. —南京: 江苏凤凰科学技术出版社)

From 1960s to the beginning of the 21st century, the problem of interaction was basically on the margin of architecture study. It was regarded as a technical problem rather than an architectural problem not until the avant-garde architect group like “Archigram” (1960s) founded to challenge the conventional concept of architecture. “Archigram” strived to propose their design philosophy in three major emphases of “non-permanence”, “non-immobility” and “non-standardization”. These definitions are no longer constrained by conventional concepts of architecture but rather motivated and inspired by the development of an embryonic stage of interactive architecture, namely kinetic architecture back in the 60s. (Chang, J. R. (2018) *HyperCell A Bio-inspired Design Framework for Real-time Interactive Architectures*. PhD dissertation, Delft University of Technology) Coincidentally, it was at the same period of time that “Cybernetics” had been brought into consideration which laid the technical theory foundation for the coming interactive architecture. When we mention about “interact” in common sense, it usually means the changing process initiated by human. In terms of that, Cybernetic theorist Gordon Pask also emphasizes the notion in his article (1969) (Pask, G.(1969) *The Architectural Relevance of Cybernetics*. *Architectural Design*, September issue No 7/6, John Wiley & Sons Ltd (London), pp 494-6), “as the underpinnings to the comprehension of architecture as a compilation of active systems, in contrast to the perception of a building as simply a static material object, where the engagement of the human is, most critically, lost.” Obviously, scholars had realized the important and active role of human in the cybernetic architectural revolution at an earlier stage. As with all technological revolutions, people meet possibilities and pitfalls at the same time. Under no circumstance, technological innovation would digress from the aim of humanization. For example, as influential architect Christopher Alexander said, parametric design was meaningless and no other than number games to human if it had no connection with people’s daily life. Thus, it is researchers and architects’ responsibility to carefully identify the prospect which did most to our environment, society and culture, not to be blinded by phantom of technological explosion.

In an era of global technological development, architecture and design practice and theory have experienced unprecedented changes. Embedded computing has increased

mobility and given rise to a new breed of highly mobile, technology-dependent, wireless professionals, or neo-nomads who can work and communicate across the distance. (Abbas, Y. (2004) Neo-nomads and the Nature of the Spaces of Flows. In: Proceedings of UbiComp in the Urban Frontier) In response to the neo-nomad lifestyle, the instability and temporality of inhabitant demand have given rise to the change of dynamic and adaptive architecture. The general public as the participants of producing social space, now has the aspiration to communicate with the urban environment due to the technological advances which enable conversation between people and space in real time. Vice versa, technological innovations have facilitated new forms of human-space interaction. (Jakovich, J. & Beilharz, K. (2007). Interaction as a Medium in Architectural Design. Leonardo 40(4), 368-369. The MIT Press.)

Shenzhen has achieved technological modernization due to the inclusive environment for innovation since it was established in 1983. Citizens have been adapted to the rapid development of technology in Shenzhen. Owing to welcoming policy and atmosphere, millions of people have moved to the city to fuel the industry. Notably, fast increase of population within a short time always results in urban problems such as housing shortage, environment pollution, and high population mobility. This specific segment of the population inhabits a dematerialized world of portable computing, mobile technology, digital and social media, and continuous online presence. (Naz, A. (2015). Interactive Living Space Design for Neo-Nomads: Anticipation Through Spatial Articulation. Cognitive Systems Monographs, 393–403. [https://doi.org/10.1007/978-3-319-22599-9\\_23](https://doi.org/10.1007/978-3-319-22599-9_23)) With a highly independent lifestyle and a lack of family origins in this city, the people living in Shenzhen are the “Neo-nomads” literally. And Hong Kong shares the similar situation with Shenzhen not only because of their neighboring locations but also the analogical population mobility. Thus, the Shenzhen-Hong Kong twin cities are the ideal test ground for interactive architecture experimentation. What is more, the theme of Bi-city Biennale of Urbanism/Architecture (Shenzhen) in 2020 is going to be “Urban Interactions” which will officially launch a universal topic featuring both philosophical significance and valuable innovative application.

### 3. Conceptual & Practical Case Studies

Like all emerging field, interactive architecture has experienced both dilemma and breakthrough for a long time. It is important for current researchers to learn from the cases whether it used to be “phantasmagoria” or will be a “quantum leap”.

Before those prototypes being invented utilizing current technology, one project, though never realized, is one of the first interactive architectural project implemented by architects, planners, cybernetics experts and computer experts. Proposed by avant-garde architect Cedric Price, the “Fun Palace” could be changed according to the desire of the visitors. British cybernetic expert Pask and other cyberneticians also involved in the project which introduced cybernetic thinking into the field of architecture, laying a theoretical foundation of architectural cybernetics. Although their pioneering experiment wasn’t able to be carried out in reality, it still greatly influenced later generations of architects.

In contemporary society, one of the most outstanding practitioners is Estudio Guto Requena located in São Paulo, Brazil. The team concentrated on experiments with digital technologies in an emotional way. Among many innovative projects Estudio has done, one of the excellent works - “Mapped Empathies” is a typical prototype which well illustrates the whole idea of interactive architecture. It is an experimental research project that seeks to explore possibilities of adding new digital technology into urban furniture. As a performative urban furniture piece, the experience worked when visitors were connected with each other in an interactive and dreamlike form that blurred the boundaries between the street, technology and feeling. People were connected and immersed with the same experience in the installation. In the aspect of aesthetic, the project had reached a fairly high level with its harmonious lights and sounds design when the temple-liked shape echoed the atmosphere of meditation perfectly. This means that the design of the space can firstly evoke the public’s desire to come and explore it. For the technical solution, the idea of interaction was realized through finger sensors on the bench that captured participants’ heartbeats by touching it. By doing so, each individual’s heartbeat could be heard and then the generative music software mixed and transformed heartbeats into a symphony which made the architecture a large sculpture of emotion. Undoubtedly, this project has achieved stunning result not only for its effective interaction between participants but also the adequate works on testing shape, hardware (software) and people’s reaction.

In academia, a group of researchers are also committed to the subject of interaction and architecture. Design for Performance & Interaction March is a 15-month master programme taught in The Bartlett School of Architecture UCL, teaching students to design performance and interactive experiences. The cooperated Interactive Architecture Lab has enrolled an array of artistic and technical backgrounds to work with interactive technologies to consider objects, space, people and systems as potential performers. Similarly, students in this programme intended to develop their design skills/research

abilities/scopes on interaction and performance informed by multidisciplinary theories taken from performing art, digital media, spatial interaction, anthropology, sociology, cybernetics, cognitive neuroscience and aesthetics. The Interactive Architecture Lab students have accomplished a certain number of interaction projects as well as research outputs under the supervision of program director and fellows since 2012.

It is worth learning from the precedents that the composition of team members from diverse backgrounds is the primary factor of building an interdisciplinary team. Meanwhile, a strong technical support by professionals and specialists is essential every now and then. Professionals and specialists from other disciplines should be highly encouraged to join the design project from the beginning till the end of it. In that case, the key role of the teacher is to control the whole process and be able to motivate creativity in the exploration of the subject. Besides the orderly organization of group, it is also important to come up with a philosophy of doing architecture in a boundless way for all the practitioners involved. After all, the most different part is not the technical problem but the constraints on traditional architectural canons and architect's role.

## 4. Methodology of Interdisciplinary Pedagogy

The boundary between different disciplines has become vague when design and research methods, multimedia representations seek to collaborate with social anthropology, digital technologies, mechanical engineering, and performing arts. The rising of interactive architecture has indicated that the public were not satisfied any more with static substances from which things are made for urban realm. Instead, it is the immaterial and intangible experiences which interactive architecture seeks to create that encourages people to shape the space by themselves and verifies the truth that architecture is becoming more intelligent. Accordingly, the way architects think and work is going to be more intelligent and adaptive insofar as is the core value of design pedagogy discussed in this paper.

### 4.1. Interdisciplinary nature of architecture

Architecture has always been considered as a combination of art and technique. As Roman Vitruvius defined Architecture as "a science arising out of many other sciences, and adorned with much and varied learning; by the help of which a judgment is formed of those works which are the result of other arts", setting its mixed character, both theoretical and technical. (J. Perez Gil, L. Santos y Ganges, R. Almonacid Canseco, J.L.

Lalana Soto, J. Garcia Nistal, V. Jimeno Guerra (2016) INTERDISCIPLINARITY IN ARCHITECTURE: TOWARDS A GENUINE CROSS-DISCIPLINARY EDUCATION, EDULEARN16 Proceedings, pp. 6362-6367) From the onset, one of the main features of architecture was its interdisciplinary nature. In the era of information and technology, however, people now are exposed to an exponential growth of knowledge in every field of human world and the theories of each discipline could be easily accessed through the Internet or any tangible literatures. Accordingly, it is much more difficult for architects to learn every part of art and technology nowadays in order to follow its interdisciplinary trajectory. Therefore, they should be equipped with at least one foundational understanding in domains like engineering or computation in order to develop the skills necessary to explore, conceive, and design such system. That is the reason why external support from multiple professionals are needed instead of self-studying electronics, mathematics or biology in researching Interactive Architecture design. It is therefore, timely for architects and designers to meet the turning point of changing the traditional way of thinking in architecture and the role of architects.

#### 4.2. Prospect of Interactive Architecture design in China

In China, with the rapid development of technology and culture, architecture and design education are constantly changing itself to meet the market need while bringing space creation into high technological level. This year, the thesis project addresses on the public life in transportation space and take “Shenzhen Futian High-Speed Railway Station” (“Futian Station” in short) as the case. “Futian Station” has just been started to use, connecting with Hong Kong City in only fifteen minutes. While operating as a transportation node, it was also planned to serve as a platform for various cultural activities in response to Hong Kong West Kowloon Cultural District which was exactly the connecting railway terminal located. In other words, “Futian Station” has a great potential to become a complex of transportation, commercial and cultural space open to the public. Nevertheless, at the moment, much space is still left unoccupied or inefficient. Expecting increasing ridership in the future, the station will become a huge hub for public activities in the coming years as “commuting” has become a common status of neo-nomads. Obviously, the “commuting” status reflects a typical aspect of modern lifestyle. However, instead of indulging in smartphone world while absent in the real world, people need to look up and get in touch with the physical surroundings. In response to the mobility of transportation space, a more kinetic and responsive architecture would definitely reflect the atmosphere of “commuting”.



### 4.3. Pedagogical framework of Interactive Architecture in Shenzhen University

With the intention above, the thesis project seeks to collaborate students with multiple professionals to develop a solution for public space activation through a series of methods including seminar, site visit, mapping, filming, public engagement and computational modeling. The teaching method was carried out with five undergraduate students in interior design or digital media and two experienced mechanical engineers. As for the mechanical engineers, they were also asked for aesthetic consultation to improve their commercial projects which indicate a certain demanding for new forms of interior space. Therefore, it is also an opportunity for interdisciplinary learning approach called “collaborative learning”. Since most of the interior design students have never been exposed to the new design approach, the first thing was to give the students an introduction about mechanical engineering with simple prototypes in order to remove the psychological barrier the design students tend to have towards unfamiliar disciplines. By doing so, the students have gained some fundamental knowledge of mechanism and dynamics through seminars with professionals and visited commercial projects on site. Through brainstorm and discussion, the students and teacher had a better understanding of how architecture works dynamically at technical level whilst communicating artistic ideas with the engineers as needed. Promisingly the team would have a shared experience and a great result by the end of the project this year. On the following stage, the design process will be exploratory in nature because it aims to determine the present factors as well as facts that are not yet explored about the phenomenon of public commuting. Exploratory research will enable the students to look at both descriptive and exploratory manners. It will look into the phenomenon by exploring the views of different sets of participants. In addition to literature review and case study, the students will be introduced to visual mapping and filming methods for analyzing public mobilities and the motivation of human behaviors which lead to the social relationship study. Related data will be collected through sources, such as architects’ works, websites, interviews and public engagement. Nevertheless, the complexity of social relationships still remains challenging to map since social networks and groups albeit occur in a spatial context are considered beyond the spatial dimension. In this case, the study of social anthropology is necessary to be integrated into the research in consideration of the limitation of single subject study. Concerned with the expanding research area, an interactive design lab is strongly recommended to build up based in Shenzhen University, which would bring all the research and experiment procedures into better organization and find new dimensions with the concept of interactive architecture.



#### 4.4. Educational position

The academic significance of developing interdisciplinary pedagogy is not only for the training of future architects aware of interactive architecture, but also change the way of traditional Interior Design education in China. In response to the changing world, especially the rapid social reform in China, the syllabus of Interior Design major need to be revised and expanded beyond interior decoration since established thirty years ago. On the contrary, we should observe the outdoor space (urban environment) more than a single interior unit and think deeply into the formulation of space and culture. Also, as a complementary major with Architectural Design as known, an innovative pedagogy for Interior Design might also narrow the gap between different design majors, achieving a better understanding for urban environment in common context. In this approach, the conventional courses are going to be reconsidered to formulate a series of collaborative labs such as interactive housing, intelligent furniture or mobile urban infrastructure. This will probably lead to an interactive revolution of design pedagogy.

### 5. Conclusion

The discussion in this paper intends to provide a platform for further research and experimentation in the realm of interactive architecture and to encourage the students to rethink the relationship between human need and responsive space since there were still many unexplored areas of design and many possible intersections of different disciplines to be discovered. This paper also aims to propose Shenzhen as the testing ground of interactive architecture in China. For the reason that, it has a large population base to support the interactive experiments. Since the high population mobility and fast reaction among public would benefit the experiments with abundant feedbacks which might contribute to facilitating the development of interactive architecture.

Interactive design system is a boundary crossing working process involving knowledge and skills of mechanical engineering, digital technology and social sciences which has the most fertile soil in Shenzhen with all kinds of specialists; As for architecture and design students, they should acquire more than one foundational knowledge of domain other from their own in response to the increasing need for interdisciplinary talents. It is important to encourage communication between students and teachers from different disciplines to provide fruitful ideas. With all the necessary elements, the innovative interactive architecture design thinking will probably advance the next level of artistic and technological discourse in China. Prospectively, more interactive tryouts will be

implemented through interdisciplinary teamwork in the coming years and the definition of interactive architecture is expected to be widely broadened.

Yet many explorations and related methodologies need to be put in a theoretical framework. We can start from learning distinct cases, figuring out the internal logic between related disciplines, trying to formulate a comprehensive framework in order to guide a sustainable urban development. Hence, working as both a lecturer and a researcher, the author is urging to put forward the idea of interactive architecture and trying to improve architecture and design pedagogy in the local context of China.

## Conflict of Interest

The authors have no conflict of interest to declare.

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