

Responsive Architecture

Research plan

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Responsive Architecture

Problem statement:

Our environments and cities will undoubtedly change due to artificial intelligence-powered technologies. The smart home may be one where we have to deal with a clothing rack that constantly criticizes our fashion choices, a door that emits an encouraging sigh as it opens and welcomes us home after a long day, or a Romba-like servant who is depressed because his model is being discontinued. Certain Measures in their installation “HOME IS WHERE THE DROIDS ARE” proposes a design that illustrates the struggles that we might have to deal with daily in the distant or not-so-distant future.¹

However, such speculations might seem distant, given architects’ relatively slow adoption of digital technologies.² Several emerging innovations have begun influencing architecture, yet architects rarely design them. Architects, particularly those in practice, remain mostly consumers of technology rather than makers of it. Commercial software adoption, such as Rhino’s Grasshopper, which aided the adoption of parametricism, is a significant step in accepting new technology.³ The popularity of the Grasshopper, in particular, enabled the practice to use more optimization and simulation tools to make their designs.

Adopting digital tools allowed for more complex and efficient designs, yet architects’ agency in building design appears to be diminishing. The 2014 Venice Biennale installation OMA demonstrated how much of an architect’s work is outside his hands.⁴ The shift in architects’ authority raises a question of how architects should position themselves in integrating new technology into architecture. One stance is to continue the existing trend of architects increasingly serving as consultants to clients and engineers.⁵

- 1 Andrew Witt, “Feral Autonomies,” e-flux, August 2020.
- 2 Reyner Banham, *The Architecture of the Well-Tempered Environment*, 2nd ed, p. 27, (Chicago: University of Chicago Press, 1984).
- 3 Mark Meagher, “Designing for Change: The Poetic Potential of Responsive Architecture,” *Frontiers of Architectural Research* 4, no. 2 (2015): 159–65.
- 4 “Venice Biennale 2014: Fundamentals,” OMA, accessed October 31, 2022.
- 5 Mario Carpo, *The Second Digital Turn: Design beyond Intelligence*, Writing Architecture (Cambridge, Massachusetts: The MIT Press, 2017).

3 Alternatively, architects (re)claim their identity as makers of technology as part of their design profession to reclaim their authority in the building process.⁶

Large corporations, like Google and Amazon, have already demonstrated the potential of the pocket, wrist, and small-shelf-sized computers that we carry or interact with daily. Many people's sedentary lifestyles are being altered by smartwatches, which blackmail our consciousness and compel us to keep our resolutions to exercise more by constantly monitoring our activity. These AI-based technologies provide a new way of utilizing architectural space traditionally viewed as static. Resonating with Cedric Price's project for Generator from the late 1970s, which was an early investigation into artificially intelligent architecture and proposed more responsive environments.⁷(Price)

6 Alessandro Bava, "Computational Tendencies," e-flux, January 2020.

7 Cedric Price, "Generator Project, White Oak, Florida, Untitled. 1978-80," The Museum of Modern Art, accessed November 10, 2022.



Fig 1 Certain Measures, "HOME IS WHERE THE DROIDS ARE — Certain Measures," 2019.

Technology has advanced dramatically since the late 1970s & 80s, making the possibility of a responsive architecture much more plausible. The outlook on AI and how it will work has changed drastically. The Cyc Project, developed by Douglas Lenat in 1984, aimed to give computers common sense. Since the focus has shifted to machine learning, the technology behind Siri, Alexa, and Google Translate.⁹ (Newyorker) Imminently, AI will become a part of daily life as well as architectural design; designers must understand what the machine is capable of and be able to communicate their intent to the machine.

Once architects become versed in machine learning, they can begin designing and forming the technology that will be part of the architecture in the near future. This would result in an architecture that is responsive to its user, context, and environment as necessary. Such architecture would be able to react to its context and manage its environments, and its responsiveness would also extend to ecology. Consequently, responsive architecture will seek a balance between humans on one side and nature on the other.

9 Matthew Hutson, "Can Computers Learn Common Sense?," The New Yorker, April 5, 2022.



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Fig 2 Advertisement for the Heath Hero Jr., a "Loyal member of the family," ca. 1985.



Fig3 What is the agency of an architect in the contemporary design? "Venice Biennale 2014: Fundamentals," OMA, accessed October 31 2022.

6 Professional & Academic urgency:

The narratives of the 'digital' have been the topic of discussion in academia since the late 1960s. The Architecture Machine Group was established in 1968 by Nicolas Negroponte. Later the group transformed into the Media Lab, which is still running today.¹ Later in the 1970s and 1980', with the debut of AI, Cedric Price developed a number of projects that focused on developing artificially intelligent architecture. Unfortunately, most of these projects never materialized and only rarely utilized true AI.² Nowadays, there is no question that academia successfully managed to adapt and react to the digital turn. However, the work of academia still stays primarily outside of the realm of reality.³ The academia has been relatively crafty in making and implementing its technology; however, the practice primarily relies on commercial software.

The gradual onset of parametricism in architecture practice allowed designers to achieve a more optimised building form that resulted in higher building efficiency. However, these tools cannot yet encompass the social, political, and contextual aspects of buildings, which are the essence of the profession.⁴ However, more recently, there has been a move to computational tools outside of optimization and simulation. These are no longer just tools for making but rather tools for thinking.⁵ However, it is important not to see these technologies as 'magical' machines. It is necessary to understand them deeply to remain critical of them.

It is important to note that architects are already calling for more controlled and educated use of AI. Academic and designer Sarah Williams highlight that it is essential that data is used for good.⁶ The adoption of AI relies on access to data, so it is detrimental that the right policies and (moral) standards are set on the ownership and sourcing of this data. Most importantly, Pasquinelli and Joler call for a critical stance on AI. They argue that we refrain from embracing AI as a standalone entity capable of operating autonomously, as a form of mathematical absolute. It is necessary to consider AI as a human-made artifact that can be utilised for varied outcomes.⁷

- 1 Jeremy M. Norman, "The Architecture Machine Group at MIT Produces the Videodisc 'Discursions': History of Information," accessed November 2, 2022.
- 2 Stanislas Chaillou, "The Advent of Architectural AI," Medium, January 3, 2020.
- 3 David Rodrigues Silva Dória et al., "Public Parts, Resocialized Autonomous Communal Life," *International Journal of Architectural Computing* 19, no. 4 (December 1, 2021): 568–93.
- 4 Alessandro Bava, "Computational Tendencies," e-flux, January 2020.
- 5 Mario Carpo, "The Alternative Science of Computation," accessed November 7, 2022.
- 6 Sarah Williams, *Data Action: Using Data for Public Good* (Cambridge, Massachusetts: The MIT Press, 2020).
- 7 Matteo Pasquinelli and Vladan Joler, "The Nooscope Manifested: AI as Instrument of Knowledge Extractivism," *AI & Society*, 2020, 1–18.

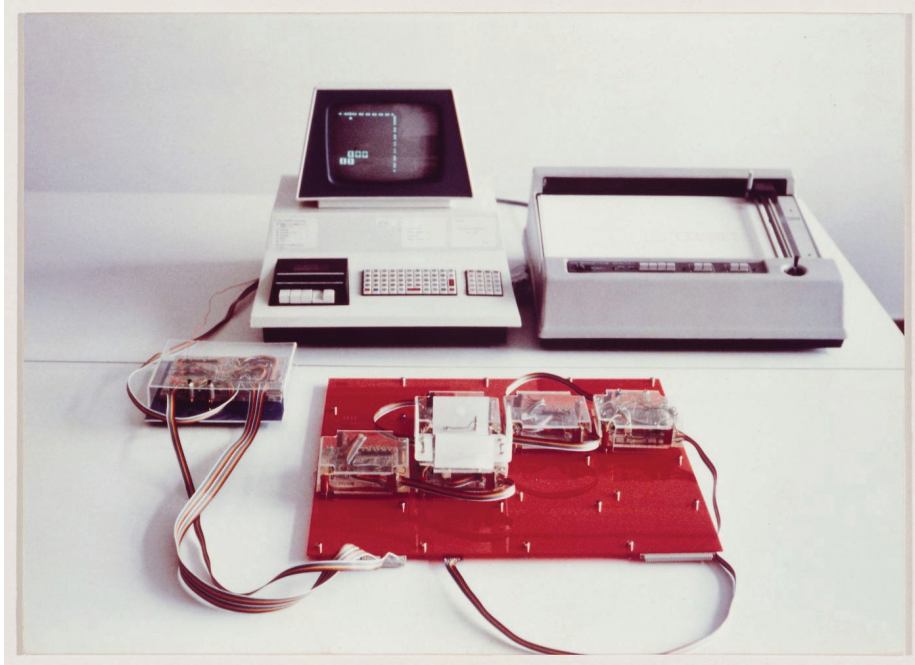


Fig 4 "A menu of individual or collective needs for space, environmental control, protection and enjoyment. A place for work, creation, thought, and reminiscence."
- Cedric Price
Architectural Review,
Jan. 1980

"In the expression 'artificial intelligence' the adjective 'artificial' carries the myth of the technology's autonomy: it hints to caricatural 'alien minds' that self-reproduce in silico but, actually, mystifies two processes of proper alienation: the growing geopolitical autonomy of hi-tech companies and the invisibilization of workers' autonomy worldwide."

Matteo Pasquinelli and Vladan Joler, "The Nooscope Manifested: Artificial Intelligence as Instrument of Knowledge Extractivism".

The Social Urgency:

Data is essential in building smart homes and smart cities. This data originates from every aspect of life; therefore, the trend impacts the whole of society. The living environment is increasingly becoming one of sensing and scanning, it is perpetually collecting data, and this trend is bound to continue growing. Architecture is shifting to a narrative where data is a design driver meant to increase the users' comfort and well-being, benefiting the user. However, this raises the question of whether we should be using data only for the benefit of certain groups or, rather, everyone, including nature and the planet. Therefore, proposing an urgency is even greater than just social.

8 Humans have always been wary of technical progress. The Machine Stops, a 1909 book, depicts the tale of a machine taking over all the challenges and difficulties of human life and leaving hardly anything within human control.¹ The story resonates, even after 110 years, because it portrays a reality similar to contemporary human existence, especially during the Covid-19 pandemic. Narratives about technology are a vital part of the critical discourse that is an inseparable part of its development. It is clear that works such as The Machine Stops by E. M. Forster or S. Kubrick Spacey 2001: A Space Odyssey remain relevant even after nearly 120 and 50 years, respectively.² These stories illustrate the negative and positive aspects, often serving as an inspiration for a discussion and design.

Adopting any new technology needs to be accompanied by discourse. AI's rise has tremendous implications for both the environment and society. Therefore, it is essential to question continuously; whether we can assume these tools to be autonomous. How can we use and benefit from automation without it resulting in a dystopian future? These tools are built on our data, so how can we approach data privacy and ownership in our personal and public lives? Can these tools be relayed with an understanding of the historical, social, and political context? Architects must address similar issues if they are to take on the role of technology designers.

- 1 E. M. Forster et al., The Machine Stops: 1909, ed. Erik Wysocan (New York: Halmos, 2015).
- 2 2001: A Space Odyssey, Sci-Fi, 1968.



Fig 5 Mechanical Turk is the inspiration for Amazons Mechanical Turk a service for labeling and organizing data that started back in 2005.



Fig 6 Life in a computerized environments — Infamous project SEEK created by the AMG. "Seek was tremendous failure; it tended to kill gebrils"

10 **Research Question:**

The digital debate in architecture has been going on for 70 years. The debate began with the idea of Computational Design. It progressed to Parametricism and eventually to the topic at hand today, Artificial Intelligence.¹ (Chaillou) During this time, various parties increasingly took over some architects' roles in the design and building process, as architects were too slow to reply with their solutions. Architects like Price presented technologically driven answers in the previous century, but the timing was not appropriate to implement them. Today, analogous organizations such as Certain Measures and the MIT Civic Data Design Lab demonstrate that architects can still design and shape technology in today's society. At their core is an 'old school' approach to design in which the architect is the technology maker.

The renewed approach of the architect as a maker will continue the legacy of digital architecture and, with it, the desire for more responsive architecture. If these responsive environments are to be controlled by machines, it is necessary to create a strategy to source the data from which they can learn. The domestic space would be a suitable place to start since it would provide a significant amount of diverse data that could be used for machine learning. However, choosing a domestic environment raises the question:

Can architects design artificially intelligent technologies as part of their design, and how will these technologies impact the design and life of domestic spaces?

1 Chaillou, Stanislas. "The Advent of Architectural AI." Medium, January 3, 2020.

Methods & expected results:

The research question can be answered by establishing a catalog of elements of artificial intelligence specific to the architectural discipline. The variety of technologies associated with artificial intelligence is vast, so it is essential to narrow the focus to those relevant to domestic architecture. This process of cataloging is done in two steps; classification of contemporary AI elements in architecture until today and an analytical forecast of AI technologies and their impact on the design of domestic architecture.

11 The classification part of the catalog starts by establishing a selection of AI-driven technologies relevant to domestic architecture. The critical selection will be made through archival research of relevant references from architecture and scholarship emphasizing recent history. The main focus points are the ‘formal’ and ‘formless’ attributes of the selected elements. The formal attributes represent the materiality of AI technology, such as its energy, material, human interaction, spatial interaction, shape, physical flexibility, and others. On the other hand, the Formless attributes cover less visible aspects, including data, privacy, software, ownership, social interaction, and more.

The classification phase provides a historical and contemporary perspective of the current state of the chosen AI elements. From this point on, educated predictions will inform a series of small designs that will imagine the responsive environments of our domestic architecture in the near future. The designs will be a reaction and continuation of the debates on responsive architecture that initially started with the work of the Architecture Machine Group at MIT in the late 1960s. These designs should also explore several possible directions of how the new elements of AI might be incorporated within homes of the future. An example of prompts for these designs might be; ‘Open-sorce home AI,’ ‘Co-habiting homes with the machinic animal,’ ‘Re-imagining the fun-loving member of the family HERO JR from the 1980s’ ad’, and more.



Fig 7 Generated image through Midjourney, "People living inside a machine" Generated on 6th October, 2022.

12 Outlook and Design:

The small designs of the elements of AI architecture completed in the second part of the research will lay down a starting point for the architectural design that will follow. The design brief will concentrate on the domestic environment of student housing. The project's prospective site is the Delft University of Technology campus in The Netherlands.

The student housing meant for the university's students offers an opportunity to directly integrate the most recent technology into a domestic environment. It assumes that the student's natural interest in technology will drive their engagement with their own homes. The students will likely possess the knowledge necessary to interact and properly engage with AI technologies. The goal of this design would be to provide an adjustable environment, which can be customized by each student by their engagement with the technology that comprises these homes.

The project will be a direct entry for the critical discussion of the 'new responsive architecture,' which runs on data collected from its users. It aims to establish, or at least rise, a question of collecting and using private data for one's benefit.

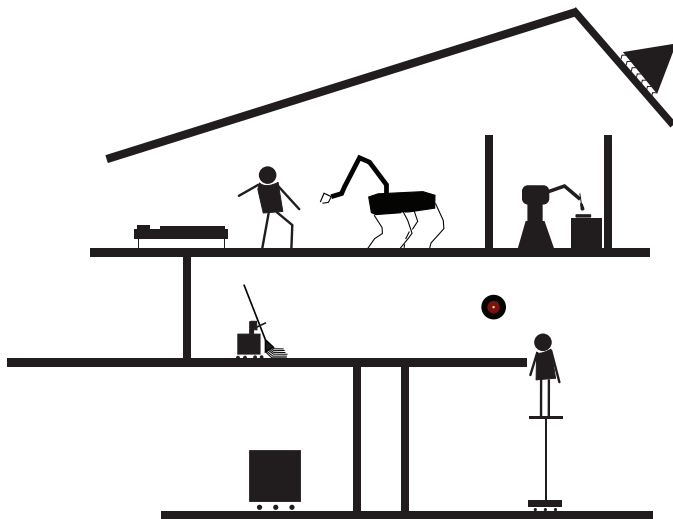


Fig 7 Sketch for the Artificially intelligent student house.



Fig 8 Jaque Andrés, "IKEA Disobedients," Andrés Jaque / Office for Political Innovation, accessed November 5, 2022.

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