HACKITECTURE: OPEN SOURCE ECOLOGY IN ARCHITECTURE

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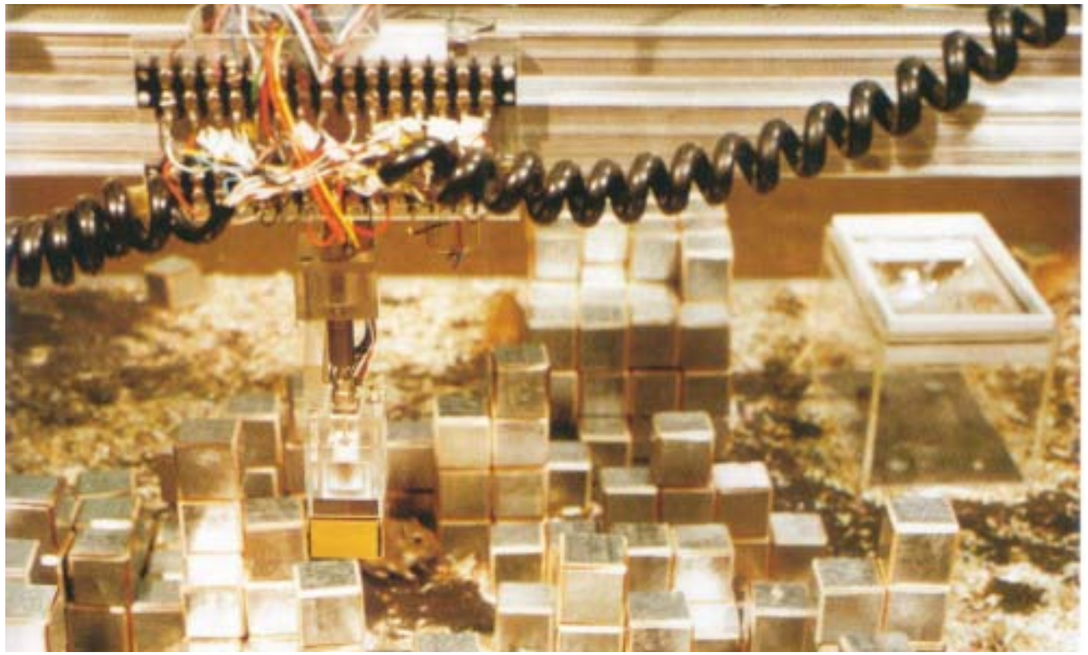


1 Seek Computer System- constituent blocks repositioned by robotic arm based on Gerbil behaviour

ABSTRACT

This paper discusses the changing modes of conception, production and consumption of architecture within the larger open source discourse. Analogies are drawn from the field of computer science to conceptually understand the relevance of ideas like hacktivism, crowdsourcing, open source, social media and user-centric approaches with regard to architecture in the twenty-first century. These ideas are discussed in relationship with the long lineage of research carried out within the architectural community regarding user participation in design. Contemporary interpretation of similar ideas is discussed with relation to how they could be systematically classified based on the nature of the "open" and the "source" as an approach toward design and architecture. Hybridizing these approaches leads to what can be termed as "hackitecture," a systemic appropriation of the hacker culture and the open source movement as an architectural agency. The essay then argues for an open source framework for architecture where obvious differences between the user and designer are dissolved, and wherein the conception-to-production and eventual conception of the architectural "object" exists as a continuum. Such a framework is discussed with respect to the technological shift emerging within the discipline. The essay concludes with the possibility of situating such processes within the larger post-capitalist sociopolitical turmoil seen today while discussing the problematics of such an approach.

INTRODUCTION

User participation in design processes has been a long-standing challenge for the architectural community. "Democratizing" architectural processes has seen a revival of interest as a result of the open source culture imbibed from the discipline of computer science. Some of this work can be regarded as an extension of the research on user participation conducted during the 1960s to 1970s by people such as Yona Friedman, Nicholas Negroponte, Cedric Price and Gordon Pask. The paper discusses the relevance of these approaches in the contemporary architectural discourse and looks at emerging technological approaches resulting in this shift. The focus of the paper is to look at open source culture in the field of computer science and related concepts such as hacktivism, crowdsourcing and social media, and to create a framework wherein the field of architecture can appropriate some of the concepts directly or as analogical frameworks. This approach becomes increasingly relevant in today's post-capitalist climate, where both the social and economic relevance of architects is being increasingly questioned. In addition, democratic post-capitalist protest movements like the Occupy movement and the Tahrir Square protests become important in this context, both for demonstrating the power of virtual networks and for highlighting the need for the field of architecture to react to such emerging sociopolitical phenomena.

The essay is structured in three parts. The first part looks at open source culture and related concepts within the field of computer science. The second part traces historically ideas in architecture that can be situated within such an open source framework and discusses the relevance of such approaches to the contemporary architectural discourse. User participatory models of the 1960s are used to compare and categorize contemporary architectural works that claim to be influenced by the open source ideology, highlighting the evolution of open source thought within the architectural domain. The third part then looks at technological developments that can potentially change the trajectory of this approach in architecture. A framework for open source ecology for the designer-object-user continuum is proposed. The essay concludes with relating such processes with the post-capitalist societies while discussing the problematics of such an open-source ecology, in and for architecture.

COUNTERCULTURE TO OPEN SOURCE CULTURE

With its origins in the "free software" movement, open source refers to free access to either the source code behind a software product or the product itself. The term found popularity in the hacker and software development circles during the late 1990s. The philosophy imbibes the idea of involving the end user in the product development process through online collaboration as a metaphor for creative individualism (Vardouli 2012, 21). The focus on the user in the open source culture has been linked to the ideological utopias envisioned by the counterculture movements of the 1960s and 1970s. Of particular significance was the influence of alternate DIY culture centered around technocultural artifacts like the Whole Earth Catalog. Fred Turner has provocatively traced the utopian visions of cyberculture to the ideals of the beats and the hippies. Turner establishes these linkages through examples of a continuing intellectual relationship between people like Stewart Brand and Kevin Kelly (Turner 2006).

The open-source movement has inspired a range of ideological siblings such as crowd-sourcing and social media. Crowd-sourcing, demonstrated best by websites like Wikipedia, solicits contributions from a large group of people, underlining the "wisdom of the crowds". The services, ideas or content produced usually also involve the end user who may or may not be an expert contributor with respect to the content being produced. Social media, on the other hand, offers an online platform to engage socially and share knowledge freely, via a virtual societal setup. Both these approaches embody the increasing online engagement of individuals to form virtual societal structures and relationships that create and share information and knowledge.

Interestingly, one of the seminal texts propagating the open source philosophy used architectural metaphors to exemplify the approach. In his 1997 essay "The Cathedral & the Bazaar," Eric Raymond compared the processes of closed and open software development as being parallel to the organizational networks of the cathedral and of the bazaar. The cathedral represents a top-down organizational system for software akin to ones developed by Microsoft and protected by stringent copyrights. This model has distinct hierarchical structures that result in lowered efficiencies and reduced creative potential. On the other hand, the bazaar demonstrates "bottom-up" emergent phenomenon—"a seemingly disconnected but functioning web of relationships on which the open-source movement is modeled" (Kaspori 2003, 13-7). Raymond highlights that this "great babbling bazaar of differing agendas and approaches" appears to work and "at a speed barely imaginable to cathedral-builders." (Raymond 1999).[1] Such an observation extends beyond an organizational critique and has direct relevance to a systemic examination of the architectural "object" itself.

OPEN SOURCE ARCHITECTURE

The last decade has seen a considerable amount of attention shown toward the incorporation of the open source metaphor in the field of architecture. But the notion of the end user that takes part in different set of processes that constitute architecture is not new. This approach has been compared to the pre-renaissance building methodologies and also to the user participation approaches of the 1960s. Paul Davidoff's "advocacy and pluralism" in planning is attributed as the pioneer of user participation in contemporary

architectural discourse (Negroponte 1975, 99). People like Victor Papanek and Christopher Alexander worked extensively on looking at indigenous modes of architectural production to make systemic frameworks for large-scale use. The "paper architects" of the 1960s too found this aspect of user involvement intriguing. The primacy of the user in design was of specific appeal to them and the discourse included shifting the control of design from the hands of the architect, considered as an external agency to that of the non-expert end user (Negroponte 1975). Individuals such as Yona Friedman and Nicholas Negroponte at the Architecture Machine Group at MIT created conceptual models for such an approach usually for the purpose of housing (Figure 1) (Friedman 1972; 1975; Negroponte 1975). For them, the architect as an intermediary "designer" was to be replaced by an autonomous "architecture machine" that could learn and understand the users' needs. The seminal 1971 Participatory Design Conference at Manchester, that involved the likes of Reyner Banham, Nigel Cross, Negroponte and Friedman participated, marked the high point of this approach (Cross 1972).

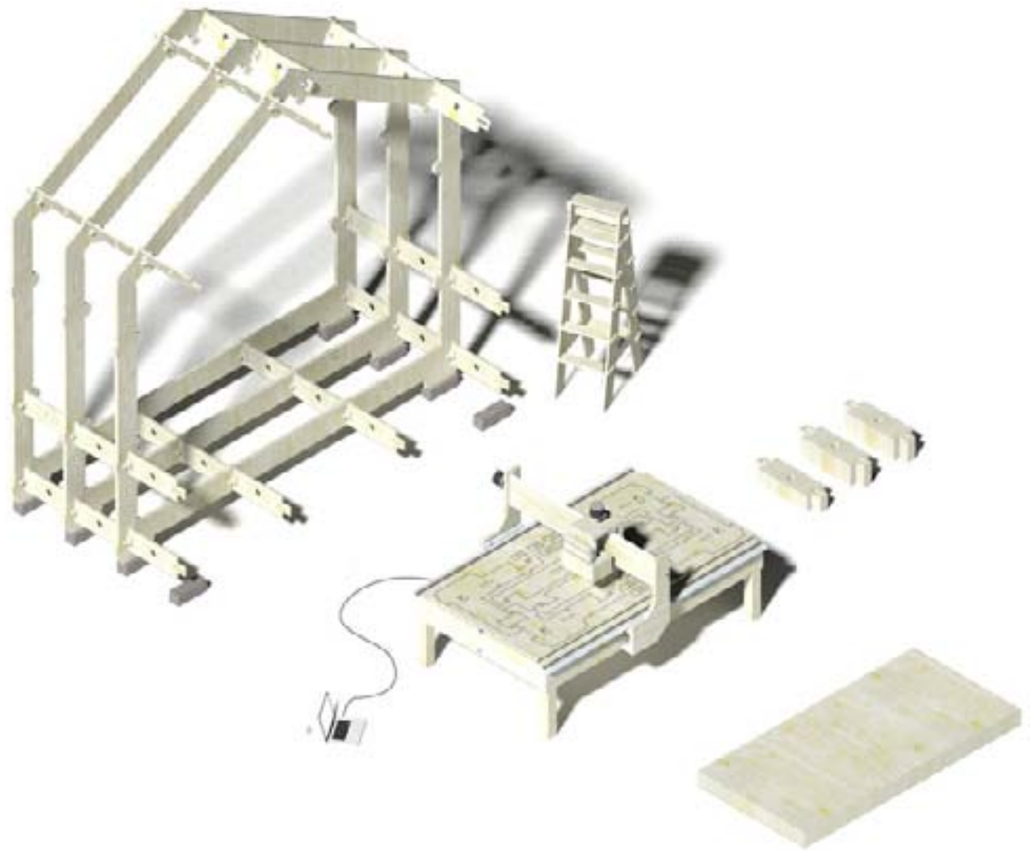
On a related but slightly divergent trajectory, Cedric Price and Gordon Pask in the UK looked at the architect as a "system designer" who conceives the design of an adaptable architectonic system. Such a system in an "enabling mechanism", allows for its users to design and modify the architecture around them, in a continuous feedback process (Frazer 2001, 641-651). These self-organizing design processes within the larger systemic framework could be scaled up for almost all public function buildings. However due to a lack of sophisticated technologies to materialize the systemic components, these projects could not be realized and the interest of the larger architectural community gradually drifted away.

During the last two decades there has been a revival of interest in this pursuit and there are a number of modes via which architectural practices are appropriating the open source metaphor. Whereas most of the architectural discourse on the subject, over the last two decades has focused on the idea of "collective intelligence" and open source as being a collaborative process between designers with various specializations, the user has almost always been ignored. Groups like Servo and Ocean, and academic programs like the Architectural Asscoiation's Design Research Laboratory (AADRL) have illustrated how contemporary computational design processes enable the shift from linear, hierarchal, closed systems to open, network based flexible models (Hight and Perry 2006; Steele 2006). Yet the lack of engagement with actual users—"the missing audience" of the architectural orchestra—still remains. Young practices such as Mass Design Group demonstrate the evolution of such approaches to engage end users, yet the pursuit of control residing with the user as speculated by the likes of Friedman, Price and Pask still eludes us.

Of interest in this respect is the Spatial Agency project, a database of the network and connections between the various actors involved in such processes since the 1960s. Most of the contemporary practices can be ideologically traced back to the seminal work of the 1960s and 1970s (Awan et al. 2011). John Frazer terms this era of "computing without computers," as a process of "mental rehearsal of what architecture and built environment would be like at the beginning of the 21st century" (Frazer 1995, 34-43). The technological shift (primarily computational advancements) over the last two decades has allowed for actual manifestation of some of these thought experiments. These contemporary architectural and urban processes that engage the user can be reduced to three larger categories discussed as the "grassroots approach", the "information-driven approach" and the "machinic agency approach," all of which are discussed below.

Grassroots approach—The first approach focuses on participatory urban-rural design and planning systems as an evolution of indigenous architectural processes. This approach, popularized by the likes of Christopher Alexander, it looks at existing indigenous processes of systemic opportunities for user participation. The focus is usually on "appropriate technologies," that enable the user or community to design for themselves via a design-build process. This process systematically categorizes the steps and makes the seemingly vague attributes of indigenous methods explicitly clear and accessible to non-experts. Here the analogy of source code can be understood to be the indigenous systems of habitat design that exist in every community. These systems can constitute a set of explicit blueprints or larger open guidelines. The architect then can be envisioned as a facilitator for the user or the community, and engages in an iterative mapping of habitat-related systems via which the process of facilitation is enabled. Nikos Salingaros' P2P (peer-to-peer) urbanism project is developing such an approach as an extension of the "pattern systems" framework developed by Alexander (Salingaros 2010). On the other hand, organizations like Architecture for Humanity, through the Open Architecture Network illustrate the open "blueprint" approach. Initiatives like Open-Source Architecture (O.S.A.) emphasize dissolving the need for a "professional" designer via a systemic open source framework that addresses the whole lifecycle including funding, design, standards and construction processes (Ratti et al. 2011). Significant progress has been achieved on an open construction process by research on modular kit of construction parts approaches as demonstrated by the WikiHouse project (Figure 2), Blu Homes and the OpenStructure project. This emphasis on (usually low-tech) "open architectural hardware," is arguably grounded in notions of materiality parallel to the bottom-up indigenous architectural processes.

In this respect it is interesting to note that the computational design paradigm in terms of a distributed agency of conception and production has also been compared to the indigenous architectural processes. In particular, Mario Carpo compares how the "digital turn" is increasingly pushing us toward the condition of open



2 Wikihouse project- open source hardware and software for a self build house

and collaborative architectures (Carpo 2013). He compares this condition with the architectural processes that existed during the pre renaissance period, when extremely complicated church designs were conceived and produced without a sole authoring architect, but rather through incremental evolution of designs via a collaboration between the community, artisans and clients.[2] It is worth noting though that the architectural product in this case was still oriented for a top down, closed organizational system (Raymond 1999).

Information-driven approach—The second approach focuses on a data-based model for architecture (Negroponte 1975,100). Here the source code analogy is used for increasing the qualitative and quantitative aspects of data, fed in by the user, which is then used to design in a conventional or generative way. The participatory aspect is grounded in the information that the users generate or provide. This data allows for enhanced decision making both for the user and the designer. Here the source code is analogous to data required for design. Usually looking at behavioral data and programmatic, environmental or economic information, the approach involves the user in the production or mapping of the information. User-designer distinctions usually do not dissolve in such a model, and the designer typically acts as the "processor" of raw data by creating rule sets for data utilization for design decisions. There is also an increasing amount of work being done on how

social media becomes the interface via which such information can be generated and utilized. Open, crowdsourced data also provides novel ways of perceiving urban spatial conditions. Some of the works of Hackitectura, the Landscape Visualization Lab at ETH (Figure 3) and initiatives like Pachube can be seen in this respect.

Machinic agency—The third approach aims to achieve user participation through a technological paradigm. Based in emerging high-tech systems, it seeks to develop "bottom up"-enabling frameworks that are systemic in nature and designed for user feedback and interaction with the virtual or physical architectural product. This approach diverges either into the territory of anti-profession as propagated by Friedman and Negroponte, or focuses on a changing role of the profession to incorporate more user feedback into the design system as envisioned by Price et al. People like John Frazer and later Usman Haque have worked on this approach at a microscale, whereas ideas of swarm urbanism demonstrated by Leach, Kokkugia or R&Sie(n) demonstrate the approach at an urban scale. Machines as intermediaries or as embedded entities, play a critical role in the feedback system. The machine is either assumed to be a "design amplifier" that understands the user's needs and sensibilities and designs in an iterative way. Alternatively, the machine becomes a "smart" link in the chain in the cyclical information flow between the designer and end user, enabling the user to have roles overlapping those of the designer. The source code analogy in either of the cases is the technological process that constitutes the design system. These technological processes are oriented in the terms of design conception systems (R&Sie(n), Frazer), spatial experience (Usman Haque, Hackitectura) (Figure 4) or constructability (robotic kit of parts, smart responsive materiality) (Goyal 2013, 221-226).

At this juncture it is also critical to notice that each of these approaches still continues the distinction between the three normative stages of "design, construction and use" or conception, production and consumption of the architectural process (Ayres 2012, 2). This is different when compared to an open source software development process that, being virtual, easily allows for the end user to influence the design and production process in a nearly real-time way. The architect of the "end product" has defined yet varying roles within these stages. When the architect designs an open source design conception system, the emphasis is on user-based information and on the interactive design systems that allow user feedback directly or through an agent-based modeling system. Here the designer is supposed to create an information structure within which the user can modify the physical or virtual manifestation of this information. A more advanced version of the same idea will imply that expert users can contribute to the structure itself. On the other hand, when the emphasis is on the open source "production" system, then the usual approach involves the designer designing a "kit of parts" or "Lego blocks," which the user then can play around with and customize. In this way designers open up their domain and allow for non-designers as hobbyists or end users to contribute toward the generation of design knowledge.

3 Synchronous Horizons – data set visualization to generate information landscapes.

4 Open Burble - installation at Singapore Biennale 2006.

In such an analogy, it becomes important to examine what aspects in architecture constitute the hardware and the software for such a system. For Usman Haque, the tangible physical attributes are the hardware and the intangible experiential attributes are analogous to software (Haque 2005, 3). It can be argued that the material processes that govern how the information system flows are what actually constitute the hardware. As in the computational world, the hardware or material processes govern the way that the user interacts with the software. The architectural hardware is then based on physics-based natural rule sets. In such a construct the software analogy can be further split into three different hierarchical parts: programming languages, operating system and applications. The scripting or programming language via which software interacts with the hardware or material process can be compared with the canonical notions of form, function and meaning in architecture. The operating system can be compared to contextual operating frameworks via which architectural processes operate within the rules that the script provides. The idea of an "application" can be compared to the individual spatial experience shaped by programmatic rules via which the user engages with the system.

It should be highlighted that both the hardware and software for architecture are interrelated in nature. The hardware aspects govern the way that the software interacts with the system and results in production and experience of architecture with physical manifestation.

HACKITECTURE: OPEN SOURCE ECOLOGY FOR ARCHITECTURE

The "mash-up" or hybridization of the three approaches discussed earlier leads to the idea of "Hackitecture," an opportunistic hacker-like approach to design and architecture based on involving the non-expert user. Authors like Eric Von Hippel have illustrated the phenomena of innovation communities where end users act as sophisticated developers-designers as observed in the design development of adventure sport equipment, specifically kitesurfing equipment that was primarily user-led design evolution (Hippel 2005, 103). Involving the user leads to highly specialized niches, which can contribute toward the advancement of the overall architectural discourse. It is interesting to note that the architect's experience as the user of design software products has triggered the computational paradigm that has resulted in the development of some of the most advanced software tools used in architecture today. Gehry Technologies is a suitable example of the "architect as the user" developing and designing a customized and highly sophisticated product (Digital Project/CATIA). This trend can now be observed in most major practices, as a need to have a specialized computational research team that functions independently, developing in-house scripts and designing computational routines for the larger office, especially with a focus on design and fabrication.

One of the key concerns of open source architecture is that of overlapping roles of the user with the designer. Another aspect that emerges from the preceding discussion is the speculative possibility of the three stages of conception, production and consumption merging into each other. Such a system then is similar to a biological process, where continuous feedback results in a conception-production-consumption continuum. In such open source ecology, nonlinear processes allow for real-time material effects, where user requirements and interaction lead to continuous adaptation of the physical manifestation of the designed object. The architectural system, then, much like a social media platform, is not confined within its physical boundary and is in constant negotiation with the user needs for differentiation, performance, resources and spatial experience.

The technological paradigm for such a shift is visible on the horizon. Evolutionary design tools, genetic algorithms and multi-agent modeling are already leading to increasing possibilities of bottom-up systemic design tools as compared to top-down approaches, which are currently the norm . Such tools allow for rule-based generative designs where generation of forms and its iterative optimization and evaluation are built into the system. Holographic and volumetric displays offer the possibility of a virtual real scale human interaction with such a system, which can lead to increasing non-professional user involvement. At the same time, extension of building information modeling (BIM) into this domain will allow for increased production information to be embedded into such a system. On the other hand, developments in rapid prototyping and physical computing allow for intelligent "hardware" to be produced by the user without specific expert knowledge. Also, emerging trends of geo-specific social networking, augmented reality and projected-interactive environments could be embedded into such architectural systems. These technologies combined with the social trends of "maker spaces" and DIY urban communes in the city offer collaborative and shared platforms for production of such a system. Yet, wide access to these technologies is critical to their adoption.

The incorporation of such an "open source ecology" could lead to a paradigm change in the architectural discipline, but it is not without its own set of problems. For instance, there remain question marks over how efficiently the non-expert users can generate designs as sophisticated as those of an expert, while still addressing all the complexities of the design process. Also, issues of authorship and ownership are always critical. Of concern too is the fact that unlike virtual systems, the physical manifestation of architecture encompasses engineering liabilities. These are critical issues that need to be addressed by any such system, before it can claim to be truly "open".

One can look at the various modes of how interpretations of "open source" in computer science address the issue of authorship for probable analogical situations in architecture. For instance, there could be the idea of creative commons licensing in architecture that allows the designer to retain claim over the knowledge produced. On the other hand, one could argue that it is highly improbable to have a copyright design model in architecture, with almost all of architectural progress based on the idea of inspiration from preexisting architectural models. Similarly, liability in relation to the usage of the architectural product is another gray area. Is the user liable for using an open source architectural system to design and build a house that eventually collapses? Or is the system designer or the intermediary architect liable? These questions remain and a detailed discussion of these aspects is beyond the scope of this paper.

The architectural community also needs to proactively respond to and appropriate emerging trends of geo-specific social networking, augmented reality and the "Internet of Things" that is most likely to soon be mainstream. Corporations like Google, Microsoft and Facebook (along with the app/plugin ecosystem around them) are already developing such systems that will significantly influence the physical habitat around us. It is vital that contemporary architectural processes critically address the need of the users to be active participants in shaping the environment around him/her, as a party for whom these technologies could become a convenient but superficial vehicle for achieving a customizable and adaptable built habitat. A constructive dialogue would allow for a seamless integration of intelligent technology into the built habitat without either party dominating the other, while still permitting a degree of unexpected outcomes (in the spirit of Pask-ian convestaion) . The recent global phenomena of democratic post-capitalist protest movements also highlight the role of virtual networks and necessitate a critical interrogation of contemporary architectural processes and the nature of their engagement with the larger sociopolitical context.[3]

CONCLUSIONS

This paper argues for an open source ecology that employs accessible technological platforms in a systemic way. The system is constructed based on analogies drawn from the field of computer science, from ideas like hacktivism, crowdsourcing, open source, social media and from user-centric approaches with regard to architecture in the twenty-first century. The role of the architect in such a system moves away from that of producing "objects" for consumption, heading instead towards becoming the lead generators of knowledge systems for interacting with the habitat. In this process the architect also enables the non-expert user to perform most of the present tasks of architecture without the requirement of an architect. This involves a hacker approach toward opportunistically appropriating emerging computational technologies to create "meta-design systems" that enable users to design for himself/herself - an approach termed "Hackitecture". In the era of Wikipedia, Facebook and Maker Communities, when DIY ideas of the Whole Earth Catalog are no longer counterculture phenomenon, such approaches offer the field of architecture a means to maintain its continued relevance through a constant process of negotiation with the socio economic flux of our contemporary society. Nonetheless, such a construct has its own set of problematics that need to be examined and debated conclusively. That said, Hackitecture possibly offers a framework to position and orient the idea of architecture in a post-capitalist scenario, as a *détournement*[4] of what it is today.

ENDNOTES

[1] It is also interesting to note that the seminal text by Douglas Engelbart (*Augmenting Human Intellect: A Conceptual Framework*, 1962) also uses the architect as the actor for describing the usage of the computer as a "clerk" system.

[2] See also Mark Burry's discussion on the open design framework created by Antonio Gaudi; Mark Burry, 2012, "The Persistence of Faith in the Intangible Model," in *Persistent Modelling: Extending the Role of Architectural Representation*, ed. Phil Ayres (Abingdon: Routledge).

[3] See discussion on "Multitude" in Michael Hardt and Antonio Negri, 2005, *Multitude: War and Democracy in the Age of Empire* (New York: Penguin Group USA).

[4] See discussion on the subject by GE Debord and the architectural history of the idea in Simon Sadler, 1999, *The Situationist City* (Cambridge, MA: MIT press).

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