The Archigram vision in the context of Intelligent Environments and its current potential

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Abstract **– Formed in the 1960s cultural milieu, the Archigram avant-garde group envisaged and designed architectural environments able to respond to indeterminacy, individual choice, desires and needs. Their vision for an architecture able to provide instant services, automation and comfort, through cybernetic interfaces and robotized systems, seems to meet today the Ambient Intelligence (AmI) vision, applied in the so-called intelligent environments (IEs). Although outside the architecture discipline, these applications are able to proactively enhance and cater for people's life and needs either through autonomous/adaptive or user-driven control. This paper examines analogies and dissimilarities between Archigram's work and IEs looking at both their intentions and projects. It is argued that mainstream intelligent environments involve a functionalist flexibility paradigm, unlike Archigram's proposals. On the other hand, alternative types of intelligent environments, i.e. the so-called *user-driven*, seem to near Archigram's vision for indeterminately flexible spaces. Yet, the apparent potential of Archigram's experimental projects and hardware, especially those that are kinetically driven, is far from that vision and the capacities of user-driven IEs. The paper further examines contemporary attempts to combine user-driven control, indeterminacy and kinetics in architecture concluding that, apart from research in engineering systems and novel materials, conceptual guidelines toward this end are also needed.**

Keywords – Archigram; intelligent environments; indeterminacy; user-driven; non-functionalist paradigm; flexibility

I. INTRODUCTION

In the 1950s and 1960s, cybernetic and computational control systems were imagined as metaphorical as well as literal paradigms for the design of indeterminate, self-regulating and adaptive architectural environments by avant-garde groups such as Archigram and the Metabolists, and architects such as Cedric Price and Yona Friedman. The new science of cybernetics was a key concept for the architectural avant-garde since, its founder, Norbert Wiener, in *The Human Use of Human Beings* (1947), described how information feedback was central to the creation of environmentally responsive machines [1]. Architecture as cybernetic system could thus be theoretically changed at will by their inhabitants, in order to «*adapt to the changing desires of the human communities that inhabit it*» [2].

For many years experimental architectural projects with cybernetic and computational layers remained on paper, partly due to lack of efficient computational means. However, in the 1990s the interest for computationally augmented architecture was revived as wireless networks, embedded computation, and sensor effectors became both technologically and economically feasible to implement. This led to the development of research groups, courses and workshops in schools of architecture, such as the interactive architecture workshop at the Bartlett School of Architecture and the Design Research Lab at the AA, which would explore issues of interactive and digitally-driven kinetic architecture. Interestingly, in this same period and outside the architecture discipline, the field of computer science called Ambient Intelligence (AmI) started to develop its vision for the implementation of the so-called Intelligent Environments.

In this paper we will examine and pinpoint analogies between Archigram's 1960s proposals for responsive, indeterminate, user-driven architecture and the contemporary intelligent environments, arguing that, despite their differences, current work in user-driven intelligent environments partly reflects and even radicalizes Archigram's vision. Conversely, contemporary approaches to the design of transformable indeterminate structures are discussed, which take into account the material and physical aspects of architecture and have been influenced by Archigram's projects. Thus we will propose a conceptual synthesis of AmI's properties of user-driven and adaptive control, with Archigram's visionary ideas of indeterminacy and non-predefined flexibility substantiated in

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mobile structures [3], [4]. Furthermore, the postwar cultural milieu within which the Archigram group grew, was defined by cultural shifts and scientific developments such as relativity theory, Heisenberg's uncertainty principle (1927) and Popper's attack on sociopolitical determinism and quest for open democratic societies [1], [5].

Within this context, Archigram's concept of indeterminacy -a term initially transferred to architectural discourse by John Weeks-[1] meant an 'open ended' architecture which would empower society to play an active and participatory role in the determination of architecture, thus expressing the desire for control and continuous change [6]. Archigram's images of *Plug-in City* (which are comparable to Metabolists' mega-structures and Yona Friedman's

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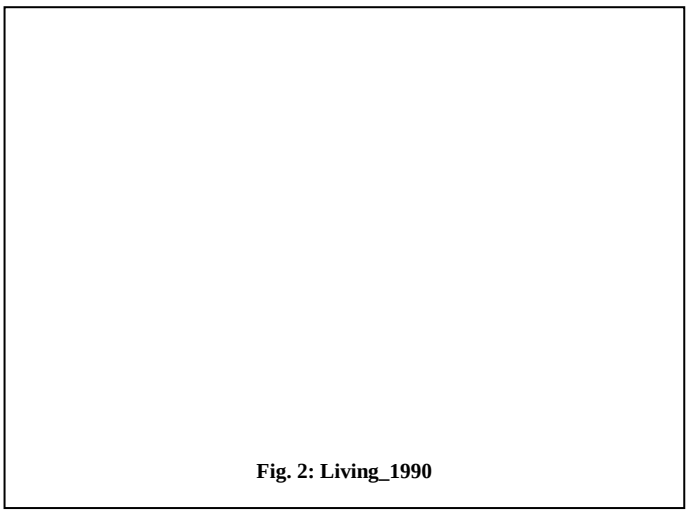

Fig. 2: Living_1990

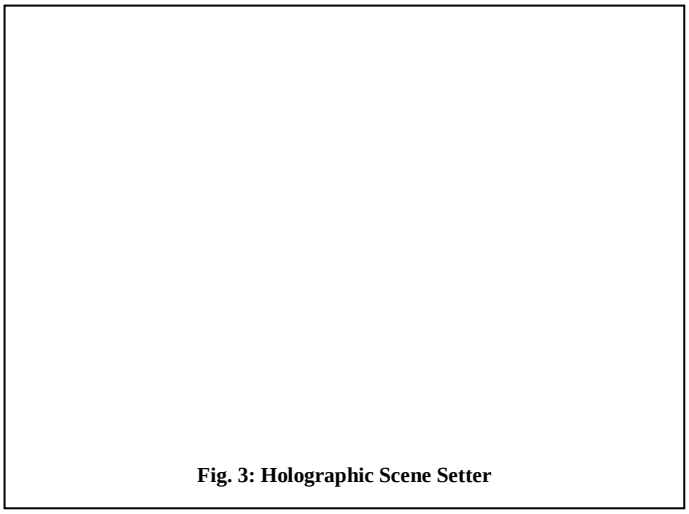

Fig. 3: Holographic Scene Setter

Archigram adopted an iconographic language to express immaterial entities of information flux, temporary events and communication [3], which, due to insufficient technological demands and limited knowledge, would not result in realized architecture. Yet, their work seems to be a harbinger of contemporary discussions and practices related to the design of adaptable architectural environments with embedded computational technology. Architectural historian Antonino Saggio has argued that the potential distribution of computation in physical space may enable architecture to expand its possibilities by responding to the subjectivity of human desires and biological needs through the use of various sensors [9]. Such an assumption seems to echo the AmI vision, and its applications, the intelligent environments, although architects are rarely involved in their design and implementation. A brief look at these applications will show their possible analogies or dissimilarities with the 1960s visionary architecture.

III. Intelligent Environments

Ambient intelligence (AmI) is a vision in computer science aiming by definition at the creation of spaces able to respond to the presence and activities of people in an adaptive and proactive way supporting and enhancing their life through smart devices [10], [11]. Although automatic buildings have been around since the 1950s and 1960s, [1] intelligent environments are different because they have developed complex and adaptive ways to enhance domestic habitation through the use of ubiquitous computing (neural nets and fuzzy logic supported by networks of intelligent agent-based systems) and user-friendly interfaces [13]. Without attempting to discuss the perpetual meaning of *intelligence* as analyzed in the fields of Artificial Intelligence and Cognitive Science, it is sufficient to say that, in the context of AmI, it refers to autonomously functioning systems able to provide automated services, assessing situations and human needs in order to optimize control and performance in architectural space. Such systems use environmental information -acquired through activity recognition / detection- as feedback to obtain knowledge and experience, through learning, memory and proactive anticipation mechanisms, in order to adapt flexibly to personalized needs as well as changes of user habits [14]. Such environments, a.k.a. autonomous intelligent environments, would include the *iDorm*, an experimental student apartment developed at Essex University [15], the *PlaceLab*, developed by House_n research program at MIT [16], the *Adaptive Home* [17], and the *MavHome* [18].

IV. Analogies and Dissimilarities

A. Functionalist vs. non-functionalist paradigm of flexibility

In the author's PhD thesis [19] it has been argued that the Archigram project, with its emphasis on user involvement and participation, constituted a "non-functionalist" paradigm of flexibility, one which Adrian Forty considers to be not a characteristic of buildings but of use [20]. In 1950s and 1960s, the uncertainty brought forth by the constant social and economic changes along with the rapid development in the Western post-war world, led to the idea of flexibility, namely, the exploration of architectural solutions capable of adapting and responding to these changes. However, as Forty argues, the application of flexibility in architectural design gave architects the illusion that they can sustain and extend their control on buildings even after the period of their real responsibility, the design stage [20]. On the other hand, "non-functionalist" flexibility is not determined by design or technical means but by the creative and constructive engagement of users with space, such as that envisaged by Archigram and made apparent in their written work. For instance, the text describing the *Control and Choice Dwelling* project reads:

"*The determination of your environment need no longer be left in the hands of the designer of the building: it can be turned over to you yourself"* [4].

Contrary to Archigram's notion of flexibility, intelligent environments are located, in our view, within a functionalist paradigm of flexibility because, although they adapt to changes of user habits/activities, their high level of system autonomy minimizes and restricts user involvement. The system models the user, their actions and behavior, albeit with many

[1] For instance the *All Electric House* built by General Electric Company in Kansas in 1953 involved remote controlled assistive services such as setting on /off the lights, watering the garden or coffee making [12].

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drawbacks and deficiencies,[2] in order to produce rules to predetermine and optimize its performance. System autonomy does not permit creative improvisation neither does it allow users to influence or modify the system's rules and hence functions. The system usually monitors the users' actions in order to adapt to new behaviors and function accordingly. The system's functions then are predetermined by design, the intelligent agents' capacities and the knowledge it obtains in time through learning. Therefore, mainstream intelligent environments cannot be regarded as a paradigm of non-functionalist flexibility which assumes the creative and participatory presence of users. Unlike Archigram's intentions, they do not allow user involvement in the determination of the functioning of the environment.

B. Autonomous vs. User-Commanded Environments

On the other hand, unlike intelligent environments'

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elements, trolleys and cars, provide ephemeral facilities, such as TV, color and lighting services, food and drink, as well as lavatory services. Travelling units provide locomotion, change of place, instant enclosure and privacy [4]. The interaction logic here is that of a hi-fi with attached buttons and predefined services: "*You turn the switches and choose the conditions to sustain you at that point in time…*" [4].

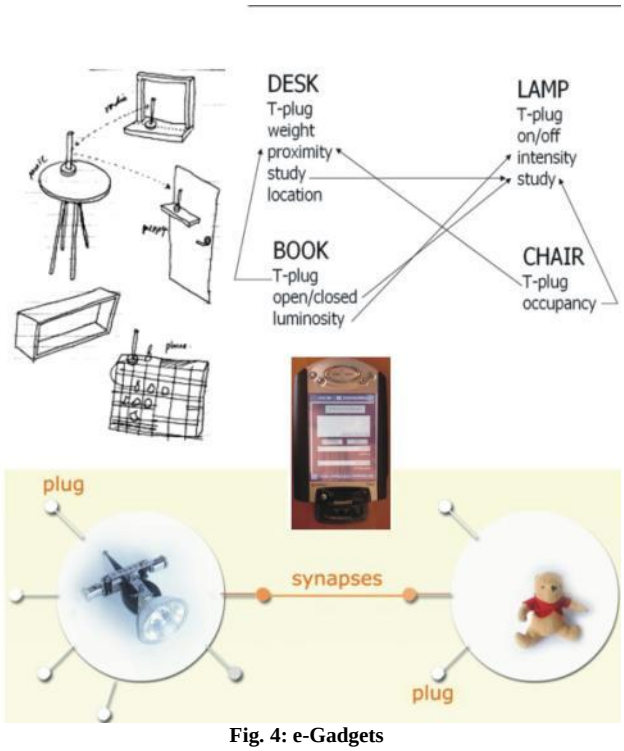

Fig. 4: e-Gadgets

Obviously, the technological advances of the time were not as good as enabling user involvement in the actual low levels of system functioning. But although user-driven environments are a current and developing project, hints of this idea were there, in the Archigram visionary proposals 40 to 50 years ago.

On the other hand, both user-driven environments and mainstream autonomous intelligent environments are not actual architecture, although they influence the functions of physical space. Unlike some of Archigram's work, where "hardware" and "software", infrastructure and immaterial flows are combined, such environments only deal with the functions of domestic appliances and interior space operations and not with architectural form or structure. Therefore, in the remaining text, we will be looking into current attempts to implement Archigram's idea of indeterminacy in actual architectural projects, through kinetic adaptable techniques.

V. Current Attempts for Indeterminacy in Architecture

Archigram's projects have been influential in providing images for the production of kinetic structures such as those discussed in William Zuk and Roger H. Clark's book *Kinetic Architecture* [27]. However, kinetic structures in Zuk and Clark's book as well as those transformable deployable structures, built by architects and firms such as Chuck Hoberman and FTL Happold, are highly functionalist in the sense that their functional capacities depend on the limited range of their transformational states imposed by the physical constraints of their structure and internal components. As Daniel Rosenberg states, kinetic architecture seems to restrict the freedom and radicalism of Archigram's ideas offering a limited approach to indeterminacy [28].

Our interest, however, is in the Archigram vision, not necessarily its implementation. Although their designs and images such as those of *Living-1990* and *Control and Choice dwelling* projects depict an inflexible, mechanically driven architecture, their vision was about open-endedness, responsiveness, indeterminacy and user involvement. Therefore, Archigram's obsession with immaterial interfaces, flux of information and minimized architecture, shows their attempt to shift away from a functionalist, mechanistic paradigm of flexibility to a paradigm based on cybernetic feedback circuits and user choice. This proposed «dematerialization» and «disappearance» of architecture in the Archigram project was driven by a social and technological milieu that favored flexibility and versatility, where building was considered to be an almost "pornographic" formal statement [4].

Recently, however, there have been attempts to radicalize the Archigram vision, to design indeterminate and user-driven transformable structures, through the use of new materials, techniques and methods as well as by revisiting Archigram's ideas and practices. Daniel Rosenberg, for instance, presented a method to materialize Archigram's concepts of indeterminacy, user-choice, uncertainty and incompleteness by radicalizing Zuk and Clark's ideas of kinetic architecture. Organized around two main ideas, "Designing the Range" and "Enabling the Choice", his experimental work involved kinetic scissor-pair mechanisms which were modified in a novel way, along with artificial intelligence methods, to enable indeterminate transformations. Combining Rodney Brook's Subsumption Architecture and Learning-by-Recording-Cases AI technique, he proposed an actuated double scissor-pair component-based structure which could demonstrate local non-uniform transformational behavior [fig.5], as well as interface directly with the real-world, without predetermined representation, and self-sense, record and learn from its own performance and interaction with user input [28].

Fig. 5: Double scissor-pair non-uniform structure

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Yet, as Rosenberg states, the possible architectural applications as well as the phenomenology of transformation of his structures are not clear. Furthermore, the application he presented was not implemented as a whole (including learning algorithms and actuators) and was restricted to scissor-pair mechanical principles. Although the work helps open up a framework to think and practice on issues related to indeterminate architecture, at the same time it remains constrained within a mechanical paradigm, which, as mentioned, presents many difficulties for truly flexible architecture.

On the other hand, Michael Fox seems to propose an abandonment of the mechanical paradigm for the design of adaptable environments. Having been interested in kinetic architecture for a long time now and having produced several works, he turns towards a more sci-fi nanotechnological direction. As he asserts, the idea of a composition of discrete kinetic structural systems and devices is outdated and should rather be replaced by an idea pertinent to the potential of smart materials behavior. This implies a scaling down of the systems that comprise adaptive architectural environments, which seems to be drawn from biomimetics and nanotechnology, using materials such as ferrofluids, nanoscale hydraulics, and smart fabrics and polymers. Such materials would incorporate sensing and control capacities, operating biomimetically at a very small scale. At this level additional attributes, besides shape, can also be adjusted and changed, such as temperature, texture, color, opacity, etc, thus engaging a wide range of human sensory perceptions, apart from functional needs [29].

VI. Conclusions - Discussion

The Archigram project was about indeterminacy at least in terms of intentions and vision, and involved environments that were controlled by user's choice and preference, in order to provide instant personal comfort and automation. As these ideas bring to mind the contemporary intelligent environments, the paper set out to investigate possible analogies and dissimilarities. It was argued that autonomous intelligent environments are located within a functionalist paradigm, unlike Archigram's intentions. At the same time, despite Archigram's attempt to dematerialize architecture and escape the constraints of hardware, several of their proposals depict a mechanical paradigm, which hardly nears the notion of an indeterminate flexible architecture.

Alternatively, user–driven intelligent environments, which present a more flexible operation based on user choice, are much more technologically advanced, beyond what Archigram would have thought of. They involve a HCI paradigm far more radical compared to what Archigram meant by user choice and user controlled environments. Yet, despite the fact that user-driven environments deal not with physical structures but with domestic appliances and operations, both user-driven intelligent environments and Archigram's work, attempt to propose a non-functionalist paradigm of flexibility.

Since the vision and the technology are present, it would be possible to think of a potential convergence of user-driven systems with actual architectural structures in order to realize the Archigram vision by today's means. This would mean that architects have to get involved by collaborating with computer scientists and engineers to achieve a possible convergence of AmI and architecture towards a truly non-functionalist paradigm of flexibility and indeterminate architecture. Architects should be thinking of novel architectural configurations, structural systems and organization of building components, modules and materials. They can then determine the possible direction of the engineering part –either biomimetic / nanotechnological or still mechanical with smart systems– while at the same time exploring the potential architectural applications. As mentioned in this paper, some architects have recently proposed possible directions towards indeterminate user-driven architecture, yet there is still a long way to go. However, this is not so much a technological problem as a conceptual one. What is still needed is a conceptual framework that will provide the guidelines to move forward. Architects exploring the potential of transformable digitally driven architecture, should be wondering why indeterminate physical structures are needed, and why flexibility in Archigram's sense -that is, instant response to individual needs- is still a matter of shape change and kinetic (or other "smarter") technical means. In short, they should be looking at the cultural and maybe psychological implications of their tendency to design and produce moving, animate architectural structures, a subject that has been explored elsewhere [30].

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