“Architecture-by-yourself”:
Early studies in computer-aided participatory design

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ABSTRACT
This paper reviews a body of literature that consists of early studies (1970-1975) in the development of computer programs empowering non-experts to create their own designs, within the broader historical context of the rejection of the modern movement’s paternalist practices and the emergence of the demand for a user-oriented architecture. The comparative analysis of these studies brings to light different approaches towards the definition of “empowerment”, the role of computers as mediators of this process and the way this objective can be expressed through software design decisions. These studies are valuable precedents serving as points of departure for productive criticism and perhaps further study in the area of computer-aided participatory design. The readings discussed in this review are “The Architecture Machine”, by Nicholas Negroponte, “Toward a Scientific Architecture”, by Yona Friedman, the collection of writings “Reflections to Computer Aids to Design and Architecture” edited by Nicholas Negroponte, “Soft Architecture Machines” by the same author and “Architecture-by-Yourself: An Experiment with Computer Graphics for House Design” by Guy Weinzapfel and Nicholas Negroponte.

Author Keywords
Computer aided design, participatory design, computer graphics, user empowerment, Architecture Machine Group, Nicholas Negroponte, Yona Friedman

INTRODUCTION
The widespread use of computer-aided design has created a vast paradigm shift in the way architecture is conceived, represented, fabricated and experienced. The expressive and constructive potential of the digital has been-and is still-being-thoroughly studied by theorists and architects who stand with admiration or skepticism in front of this brave new world. It is hard to deny that computer-aids have empowered designers to overcome the traditional constraints of thought and envision a higher level of formal and programmatic complexity with numerous aesthetic, functional and performative implications. However, architecture still remains in the hands of the architects who carry the professional expertise to successfully translate the user’s needs and desires into design. This disciplinary enclosure is further accentuated by the growing sophistication of digital architecture. The often unfamiliar vocabulary it deploys, emphasizes the role of the “expert” and makes the process of architectural design increasingly inaccessible to the user.

In the opposite pole of this, one finds a train of thought that sees user-oriented design as a way to create better products and innovative solutions. Eric Von Hippel’s and Ralph Katz’s article “Shifting Innovation to Users via Toolkits”[1] is indicative of this shift towards the “markets of one” where manufacturers transfer need-related aspects of the design to the users, offering them design capabilities via toolkits. Although this model may not be directly translatable in architecture, it brings back to the surface the question of the use of computer-aided design as a means to encourage user participation and to empower “non-experts” to express their needs and desires without the mediation of the architect.

Interestingly, before the spread of numerous design softwares, and their increasingly instrumentalist use, the concept of computer-aided participatory design was rigorously explored through a series of experiments in the United States and in Europe. The reasons that these investigations were abandoned and architecture started gradually shifting towards the disciplinary introversion that we experience today, are strongly related with major paradigm changes in architectural theory that are by no means irrelevant to the broader historical context.

This paper looks into different approaches to the relationship between computer aided design and the participatory project, attempting to link them into a coherent body of thought and point out disparities, continuities and references. The reason that we focus on “early studies” in this area, and more specifically in the time period between ’70 and ’75, is the fact that at that time the issues of computer-aided architectural design and user participation, were both very active dialogues and were characterized by a large degree of malleability, as they did not yet carry the historical burden of habit or precedence. Although their technological expressions may be outdated and perhaps mostly of historical interest, these early studies demonstrate a significant clarity in the way that they manipulate the concept of user empowerment through computers (“machines”) and can therefore provide a very fertile ground for the revisiting and the further exploration of this area.

Organization
The organization of the body of literature that we propose is mainly chronological. This “narration” scheme renders the transformations of the investigated concept through the passing of time as well as the lessons learnt from its failures, clearly discernible. The first reference is to “The Architecture Machine”[2], by Nicholas Negroponte, that focuses on the main features of computer-aided design, through theoretical contemplations and comments on related experiments at MIT. The “Architecture Machine” provides only indices towards the idea of user participation, a concept that was a few years later systematized by Negroponte, after his exposure to important influences such as the French architect Yona Friedman. Friedman’s book “Pour une Architecture Scientifique”[3] is our second field of analysis. Friedman produces a coherent scientific theory of the “democratization” of architecture and proposes the “FLATWRITER” machine as a way to realize his model of the empowerment of “non experts” in design.

The reading that follows, is a collection of writings under the title “Reflections to Computer Aids to Design and Architecture”, edited by Nicholas Negroponte. This collection demonstrates both the gradual shift in the editor’s approach towards user participation [4], as well as different tendencies dealing with the intersection of computers and participation...
emerging in Italy [5](Cesare and Gabriella Padovano Blasi), Denmark, Germany and Holland [6] (Jos Weber). In the following reading, “Soft Architecture Machines”[7] (also by Nicholas Negroponte) the term “computer-aided participatory design” is explicitly used, providing a synthesis of all the previously discussed approaches and allowing us to extract both unifying concepts as well as shifts in the way Negroponte’s and MIT’s “Architecture Machine Group” approach to the problem. Finally, through Guy Weinzapfel’s and Nicholas Negroponte’s paper “Architecture-by-yourself: an experiment with computer graphics for house design”[8] we will comment on the YONA program developed at MIT, as an implementation of this train of thought.

THE ARCHITECTURE MACHINE:
Machine intelligence and design partnership
The “Architecture Machine” is taken as this paper’s point of departure. Even though the idea of participation is not yet stated as an explicit goal, the book contains numerous indices that point towards a direction that was five years later systematized in “Soft Architecture Machines”. The “Architecture Machine” explores the issue of computer aided-architectural design, with emphasis on man-machine interaction. The issues of computer graphics and artificial intelligence are thoroughly discussed through numerous research and student projects at MIT, as well as through an extensive criticism of the URBAN5 project [9], whose deficiencies indicated most of the book’s directions. Even though “The Architecture Machine” mainly portraits the “user” as a designer or architect, it constitutes a coherent precedent that the following investigations in the area of computer-aided participatory design either supplemented or contrasted.

Towards a new “humanism”
Negroponte’s main concern is to bridge the gap between a by definition humanistic discipline, Architecture, and a field that is considered predominantly technical, Computation. Motivated by the potentials of artificial intelligence (the book is dedicated “to the first machine that can appreciate the gesture”), he proposes a model where the machine and its user develop a collaborative relationship and establish a creative and educational dialogue. However, although it is hard to deny that Negroponte’s observations concerning the preconditions for the establishment of such a man-machine relationship set the ground for user empowerment, this empowerment is only seen as a sub-goal, within a larger vision of making the process of design better and more efficient and therefore creating “more human environments”.

According to his analysis, the main problem that with architects is the fact that they are accustomed to the middle scale of the buildings and therefore prove incompetent to handle the complexities of the general (the urban) or the specificities of the very small, perpetuating a gap between the scale of the mass and the scale of the individual. In the new machine “humanism” that he envisions, intelligent machines will combine the adaptability of humans and the specificity of present day machines in order to recognize general shifts in context, as well as particular changes, in need and desire.

Negroponte distinguishes between two kinds of users for whom these architecture machines could be developed, introducing, without however extensively analyzing, the idea of a non-expert user. More specifically, he refers to a first case of “do-it-yourselfism”, where the dweller becomes the designer, through “domesticated” architecture machines that permit to each resident to overlay his architectural need upon the changing framework of the city. The second case that Negroponte distinguishes, includes the architect as a mediator between physical form and human needs. This model, which is the dominant scheme in this book, requires an architect-machine partnership, where the machine exhibits alternatives, suggestions, incompatibilities and oversees the urban rights of individuals.

Domesticated Machines and an Idiosyncratic approach to Computer Graphics
In order to achieve this partnership Negroponte accentuates the need for the creation of a natural language, that enables designers who are not computer-specialists to use their own “idioms” and establish a “vibrant stream of ideas” with the machines that they use. According to the author, this process would not only improve the designer’s productivity, but would enable him to evaluate his own ideas by making them explicit, to think about his thinking. The issue of self reflection through the communication with a machine, introduced here by Negroponte, is a very important and widely discussed aspect of the intellectual potential of computational thinking that has not lost its contemporaneity.

The main contribution of the “Architecture Machine”, is the rigorous discussion of the features necessary in the machine’s design in order to facilitate the above procedure. The first large area that Negroponte investigates, is Computer Graphics. His skepticism on the “anti-sketch” nature that computer programs tend to have and the expressive limitations that they impose on the designer, denaturing the process of design and preventing the invaluable “wobbliness” of the initial stages, is a consideration that can still be taken into account today. These concerns followed by possible solutions are discussed throughout the book, as well as his paper “An idiosyncratic Systems approach to interactive graphics”[10], where Negroponte notes “I contend that if a system is to be person oriented, that person should at least design it and should be able to change it at a moment’s notice”.

The personalization of the computer, or what he calls “a machine in residence” is a crucial condition for the success of his “partnership” model. His argument is based on the idea that this “personal contact” would enable the machine to be aware of the user’s idiosyncrasies, creating the ground for mutual and successful “interruptability”. This idea of interruptability for man and for machine that allows the process and the product to be manipulated through interaction, creating an “ecology of mutual design complementation,
augmentation and substitution” is also a fundamental concept in Negroponte’s discourse, inextricably linked with his visions of artificial intelligence and contextual cognizance, which however remains until today an unrealizable fantasy. As we will see in “Soft Architecture Machines”, Negroponte soon became highly critical of this model and restructured his concept of computer-aided design introducing different requirements and goals.

**An alternative model for Architecture and Planning**

An interesting parallel discussion that takes place in the “Architecture Machine” and creates a substrate for the rejection of the architect-expert and the shift in the author’s problematic q design participation, is the computer’s ability to respond to urban dynamics that were until then considered unmanageable. For Negroponte, in the area of design and planning, one encounters two different classes of problems: on the one hand “under-constrained” ones, that allow for intuitive solutions and on the other hand, “over-constrained” problems that are characterized by an unresolvable tension between different constraints.

Negroponte bases his entire argumentation on the assumption that the functions of communication, inference, understanding of the context and self improvement -in other words intelligence, will raise the machines to the level of valuable collaborators, not problem-solving artifacts, but problem-worrying partners of the designer, allowing him to manage inconceivable complexities and stand critically in front of his own work, with beneficial results both for him and the user. We cannot ignore, and neither does Negroponte himself, the problems of a historically defined technological optimism that considered machine intelligence as a soon realizable goal. However, the demands that he sets for computer personalization and idiosyncratic approaches to computer graphics are definitely very valuable -and rather prophetic- contributions in the field of machines designed for user empowerment.

**TOWARD A SCIENTIFIC ARCHITECTURE:**

**Democratizing Architecture**

Parallel to the studies of the Architecture Machine Group in the United States, the idea of a user oriented design that surpassed the oppressing Modernist generalizations of the “modulor” and the “medium user” had already produced significant movements that envisioned the city as a large non-defining infrastructure fostering desire and difference, allowing the individual to develop his/her own hypotheses. Yona Friedman is considered as one of the fathers of these ideas, with a major influence on groups such as Archigram or the Japanese metabolists.

Within the context of this paper we refer to the book “Toward a Scientific Architecture” that was written and published in French in 1971 (original title “Pour Une Architecture Scientifique”) and translated in English in 1975 by Cynthia Lang [11]. We believe that Friedman greatly contributed in the systematization of the philosophical implications of user empowerment, turning the concept of “auto-planification” into a consistent and multifaceted theory, while at the same time, he set the foundations for the viewing of computation as a facilitator of the user empowerment that he envisions.

What is particularly interesting here, is that the foreword of the book’s English translation is written by Nicholas Negroponte, who admits the significant influence that his encounter with Friedman’s ideas had in the transformation of his research agenda. Quoting Negroponte: “Yona Friedman has used a mathematical scaffolding to support philosophical positions in a manner which affords the reader the opportunity to disagree with his utopian posture, but still benefit from his techniques. [...] If you are a student you will find the paradoxical intersection of two academic streams - participatory design and scientific methods - too frequently held apart by the circumstances of our training”(Negroponte, 1975) Indeed Friedman greatly contributed in the existence of the very topic of this review bringing together two worlds that were phenomenally apart, computers and user participation.
Towards a non-paternalistic design: Empowering the non-experts

Friedman’s main objective is to “democratize” design, to free the user from the “patronage” of the architect, to enable “non-experts” to make their own designs, as they are the ones who better know their needs and desires and, most importantly, bear the risk of failure. Friedman rejects the idea of the average client as a non-existent entity to whom architects project their own ideas and beliefs, incapable of successfully interpreting or predicting his/her true desires. For Friedman, “the power of choice rightfully belongs to the future user”. In what appears to be an interesting analogy with Negroponte’s scheme about under-constrained over-constrained problems in architecture and planning, Friedman also discriminates between the realm of the “objective”, consisting of numerous conflicting constraints, and the realm of the “intuitive”, strongly interconnected with the user.

Taking this distinction as a point of departure and focused on residential uses that have a direct relation with each individual, Friedman devises a methodology that breaks each design problem down to enclosures, accesses and labels and uses graph theory to produce a matrix of different topologies that constitute the “repertoire” of configurations that satisfy it. By adding labels and metrics to these graphs (linkages), one can produce an infinite number of solutions potentially desirable by each client. The number of elements included in the list, calls for the utilization of a computer able to the guarantee the list’s completeness. In Friedman’s model, individual choice amongst this “repertoire” of possibilities, happens within a containing infrastructure that that carries all the necessary utilities, water, gas electricity and sanitation, and always taking into consideration this choice’s consequences for the community.

Friedman’s FLATWRITER

The FLATWRITER is a computer application of this “repertoire” that includes eight steps. The user declares his/her future desires in terms of his/her house, which are visualized through a set of symbols that are understandable by the builder and the user’s neighbors. By collecting these individual desires, the FLATWRITER is in the position to “know” whether the placement of each inhabitant will conflict with any of the other inhabitants’ declared desires.

Friedman describes the FLATWRITER’s operation utilizing the example of a user, Mr Smith, who wants to design a three-room house. The procedure is divided into two large steps: first design of the apartment and then placement in the large infrastructure. In the beginning of the process Mr Smith is presented with a 53-key keyboard that contains all the possible configurations between the three spaces, all the shapes of the spaces and all the orientations the apartment can have, in which he has to input his desire without any interference by the machine. What follows is a second keyboard, a keyboard of “weights”, where Mr Smith is asked to frequently input the number of times that he enters each room allowing the FLATWRITER to evaluate and declare whether his choice matches his lifestyle and give him the chance to reconsider his choice.

Once the plan has been finalized, the computer places it in an empty infrastructure that allows for multiple placements and small modifications that do not challenge the stability of the entire system. After “hearing” the user’s location preference, the FLATWRITER calculates the effect of this choice to its neighbors and potentially asks the user to alter it. The final stage of the process is the calculation of the global effect of this placement the information of the entire population about changes in the utilization of the neighborhood implied by each new comer’s choices, in terms of parameters such as circulation, noise, commercial value and accessibility (what Friedman calls “ISO-effort lines”).

Figure 30

Image 2. The FLATWRITER’s keys and a sample user input

Thoughts on the FLATWRITER

Friedman claims that the use of the FLATWRITER establishes a new informational process between the future user and the object that he/she will use, allowing for limitless individual choice and the immediate chance to correct errors without the oversight of a professional paternalism. The FLATWRITER is a concept software and lacks the specificity of the most of the computer-aided design platforms described by Negroponte. In that sense, its critique should perhaps concentrate in the participatory, computer-mediated model it proposes rather than its technical details. However, even at this level, one can comment on the danger of human paternalism being replaced by a machine paternalism, replacing the architect’s preconceived notions with the limitations that the machine’s design imposes.

What is more one would expect to see more emphasis in the results of the a trial-and-error process that the user follows to make his design and placement choices under the computer’s guidance. The issue of a “mistake” or a “wrong choice” as a highly educational experience that allows the
user to develop a certain degree of design intelligence, may be inherent in this process, but is not however stated as a clear goal here, nor specifically reinforced by the machine’s design. Besides these considerations, there is no doubt Friedman set the concept of computer-aided participatory design as a clear research direction, with numerous ideological and cultural implications, greatly influencing the research in this field, as the next references will prove.

REFLECTIONS TO COMPUTER AIDS TO DESIGN AND ARCHITECTURE

An album of attitudes
“Reflections to Computer Aids to Design and Architecture”, is “an album of attitudes”, with the ambition to become a comprehensive collection of projects and writings exploring past and future computer utilizations in design and architecture. The book is divided into three categories demonstrating different areas where this issue is explored, “in research”, “in practice” and “abroad”. Besides the collection’s impressive plurality of writings, it is characteristic that the issue of computer aided participatory design is rarely posited, as for the majority of the writers, computer aided design is a tool for empowering the architects and not the users or their communities. Within the framework of this paper, we are presenting the articles who demonstrate a convergence with the problematic of participation.

Jos Weber: Computers and Advocacy planning
Another article pertinent to our research topic is written by the Jos Weber, a professor in Holland (Delft) and Germany (Hamburg) and Bakema’s collaborator. Weber attempts through an exhaustive analysis of the historical perspective of the role of the architect in Europe to bring to the surface the reasons that conserve the mentality of professional expertise in architecture. It is this mentality that he consequently tries to destabilize the use of computers, contributing an alternative model of computer aided participatory design to the broader discourse.

Weber starts by posing the question whether computer aided design is “a new concept or just a quicker working method?”, to observe that the applications of computers in architecture evolve around secondary aspects, such as information and documentation systems, network planning and construction calculations, ignoring the crucial aspects of sociopolitical parameters and politico-economic programs. He attributes this purely instrumentalist approach to a phobia that is dispersed among politicians and architects, that has to do with the fact that first of all they do not have the technological prescience to control computers, secondly that they are reluctant to answer to the questions that computers pose and finally that they are unwilling to engage in the hard work of systematizing their problems and structuring them for a computer application.

According to Weber, the idea of user empowerment is inherent in the use of the computer, through the facilitation of participation and the transparency of the decision making process. The rejection of optimal or unique solutions, as well as the ideological “objectivity” that computers promote, threatens politicians and planners who insist to preserve a certain amount of professional mysticism that preserves the necessity of their existence. We bypass an extremely interesting analysis in terms of architectural historiography about the architects expertise and the reasons that computer in Europe still remained according to Weber a “sacred cow”, to refer to the examples that he presents, which enrich our
repertoire of approaches in the issue of computer aided participatory design.

We would like to focus on his description of the research conducted at TU Delft for the development of computer programs for design, structured around the creation of zones of spatial qualities that take a distance from static building programs. We note here that as we will soon see, this idea of “zoning” that presupposes a comprehensive description and systematization of both the social and the technical aspects of each design problem, is also mentioned by Negroponte in “Soft Architecture Machines” as indicative of one of the three main attitudes towards participation.

These spatial-quality oriented programs, allow according to Weber the realization of multiple connections with the real world during the decision making process. In this sense, analytical planning is replaced by self learning machines that allow the planner more time to deal with the “users” of the real world. “Until now we have seen program processes being dominated by technocratic and bureaucratic parameters, whereas in reality the considerations must respect socio-psychological, sociopolitical, socioeconomic, ecological viewpoints”. It seems that Weber also follows Negroponte’s lines, calling for a new kind of “humanism” that incorporates the use of machines, as tools for empowerment of the collectivities and a way to keep the design process open and cooperative.

Nicholas Negroponte: A change of attitude
Apart however from the articles, what is of particular interest in “Reflections to Computer Aided Design and Architecture” is the introduction of the book, where the editor, Nicholas Negroponte, explicitly orients the discussion towards the direction of user participation, admitting a major change in his personal attitude towards the potential of computer aided design. “Today, my major change in attitude is the following: given that an artificial intelligence is distant, let us consider removing the architect as opposed to emulating him. The theory is simply that many design endeavors (not hospitals or airports, but homes in particular) can be achieved by those for whom the environment will ultimately have a meaning. While this position has enjoyed a popularity in circles of advocacy planning, it has usually not encountered the support of computer aids (often a symbol of the antithesis). It has received the serious attention only of Yona Friedman in Paris, France.” (Negroponte, 1975) This last quote is a good opportunity for the transition to one of Negroponte’s writings where the idea of computer aided user participation becomes an explicit goal, synthesizing most of the concerns that the previous discussion brought on the surface.

SOFT ARCHITECTURE MACHINES
Computer Aided Participatory Design
The chapter “Computer aided participatory design” from “Soft Architecture Machines” is a comprehensive and self reflective text that summarizes the efforts in this area and sets the guidelines for future research and contemplation. The key elements of this excerpt that make it more relevant to this paper’s topic than any of the above discussed literature, is Negroponte’s self critical tone that assesses past endeavors and their failures, as well as a very high level of articulation as far as the “who” and “how” questions of empowerment in the area of design are concerned.

The idea of participatory design was definitely a shift in Negroponte’s main problematic. As previously discussed through the analysis of the “Architecture Machine” the answer to the “Empowering who?” question was somehow confounded, mainly due to an enthusiasm for the promises of artificial intelligence. Negroponte denotes a growing trend towards participation, both in design education and professional practice, mainly related with a skepticism against the architect - specialist’s capability to express the user’s needs and desires better than the user, especially in the area of housing. According to him, although the “modern” version of the demand of the user empowerment to take control of the design of his/her own house has its origins in Davidoff’s “Advocacy Pluralism and Planning”[12], it is a very old concept very often found in indigenous architecture.

Three tendencies in User Participation
In an effort to link his proposal with a specific approach of user participation and place himself within what he has earlier described as a growing “trend”, Negroponte distinguishes three tendencies of computer aided participatory design, that he presents gradually moving away from the notion of the trained architect as an expert and towards the “do-it-yourselfism” that he had only briefly mentioned in the “Architecture Machine”. The first tendency focuses on better informing the architects -who maintain the final word- about the user’s desires and developing “scientific” methodologies for more accurate estimations of a multitude’s common denominator.

The second tendency, broadly described with the term “advocacy planning” demands a certain degree of fiscal and political mobility that allows the “neighborhood groups” desires to be better heard and executed by the experts. Negroponte has already expressed his skepticism against this form of participation in the “Architecture Machine”, where he noted that the minor forms of user representation involved in it, such as questionnaires, neighborhood meetings and personal interviews, are based on the false assumption that “the asker knows what to ask, the answerer what to answer and minds do not change rapidly”.

The third approach, that Negroponte actually supports, is Yona Friedman’s proposal that removes the architect from the design process and gives total control to the inhabitant, who becomes responsible for evaluating alternatives and making the final choices as far as his/her dwelling is concerned. In search for a non-paternalistic design model the author raises the questions whether a computer can provide the necessary comfort and confidence that an architect provides, the expert’s knowledge and prior experience, as well as whether the fact
that it bears no professional risk from its failures makes its decisions reliable.

**Design Amplifiers: from Machine Intelligence to Informed Machines**

Taking as a point of departure indigenous architecture as a model of the do-it-yourselfism towards which he aims, Negroponte characterizes the existence of local conditions within unifying global forces as the alphabet of the language within which the vernacular can exist. Following this concept of a global “objective” system that allows for local intuitive solutions, Negroponte proposes a framework of a resilient building and information technology and introduces a new type of personalized architecture machine, a “Design Amplifier” that constitutes the interface between the infrastructure and the user’s ever changing needs.

Negroponte takes a highly critical position against his past studies, admits the Architecture Machine Group’s failures, calling the URBAN 5 software “the ultimate paternalist” and declares a major shift in his interest, from a desire to replicate the human architect five years ago, in the “Architecture Machine”, to the effort to make a “surrogate you” that can elaborate upon and contribute technical expertise to the user’s design intentions. The model that is proposed here is based on a separation between “talent” and “competence”, where “talent is in the eyes of the resident and competence in the hands of the design amplifier”.

**Design Education: Visiting “Designland”**

For Negroponte, the Design Amplifier should be something between the “benevolent educator” and the “thirsting student”. This issue of “knowledge” and the way it is communicated from machine to user and vice versa is one of the key points in Negroponte’s problematic. Instead of the establishment of a passive relationship where the user simply draws information from an all-knowing machine, the model that is proposed here is inspired by Seymour Papert’s experiments, where computer aided instruction is treated as the expansion and enlightening of the processes of learning and thinking themselves. The user has the responsibility to “transfer” knowledge to the computer, benefiting from this process through the acquisition of personal skills and the development of a self-reflective stature.

What is of particular interest here, is the author’s reference to the process of debugging as a highly educational and motivating procedure, that is anti-diametrical to the usual penalties of error making. Negroponte replaces Seymour Papert’s “Mathland” [13] by a “Designland” where “one learns about designing by playing with it”, expressing his conviction that even if the users will not be able to perform extremely complex tasks they will be capable of designing own homes better than anyone else.

**A Model of Design and Planning**

Negroponte builds upon the FLATWRITER, examining the two design loops that Yona Friedman proposes (“one with myself and one with my neighborhood”) in terms of automation. In the model that Negroponte proposes, during the first -private- loop the computer maintains user’s attention and asks intelligent questions, acting as a “consultant”. In this context, ARCHIT[14] is discussed as an example of a computer program that could be deployed for this first loop. In the sample user-machine conversation that is presented, however, Negroponte observes that the computer appears to be overly paternalistic, monopolizing the conversation and very soon guiding the user to specific directions through questions that “perforce flavor the answer”.

The outer loop -public- has to do with flagging disturbances when the personal desire conflicts the collective amenities. This implies that the machine has knowledge of all the desires, rules and geometry, which is considered easy, but also that it can exercise these rules within a given context. For the satisfaction of this last demand Negroponte proposes a “three dimensional zoning” that resembles what Jos Weber described as “spatial-qualities zoning” or Friedman as “iso-effort lines”, produced by a population of interconnected Design Amplifiers. In this model, there is an one-to-one correspondence between inhabitants and design amplifiers, which work in concert with a variety of larger host machines, either direct questions to other amplifiers or answering those related to global matters.

**Plan Recognition**

Having described his model of user participation, Negroponte focuses on a series of decisions on the way that the computer program is designed. An element that is crucial for him and reverses the traditional research directions in plan recognition, is the computer’s ability to infer the problem specification from the user’s input (sketches) rather than do the reverse. In order to keep the design process as natural as possible for the user, he takes a leap from his previous position about “idiosyncratic” computer graphics, to a position where computer graphics are absent in the process of user input and are substituted by a ballpoint pen and regular paper.

What Negroponte envisions is to create a machine that is able to map the user’s sketch into a graph, probably under-constrained- and make proposals to the user according to this graph, in a manner analogous to “listening to a story, extracting the main theme and developing a new narrative with similar structure”. Throughout this process the machine asks questions, aiming towards increasing the user’s understanding of the architectural implications of what he/she is designing as well as its own understanding of the user’s needs and desires.

As an example of such a plan recognition program, Negroponte discusses SQUINT, an extension of the older HUNCH [15], also mentioned in the “Architecture Machine” that uses a “flooding technique” to recognize the user’s input (drawing) and perhaps even compare it to architectural precedents. The chapter “computer aided participatory design” ends with a small architectural folly that imagines a deeper structure of
needs, formally manipulated according to different, even recognizable, styles and morphologies.

ARCHITECTURE-BY-YOURSELF
An Experiment with Computer Graphics for House Design
Following the route systematized by “Soft Architecture Machines”, “Architecture-by-Yourself: An Experiment with Computer Graphics for House Design”, written by Guy Weinzapfel and Nicholas Negroponte, describes as an experiment in computer aided design exploring computer graphics used by a general populace in order to produce residential designs. The computer implementation explored is called YONA, as a homage to Yona Friedman, a great influence in both the authors’ thinking.

This program is inscribed within a larger research agenda, “Machine Recognition and Inference Making in Computer Aids to Design” at MIT, and explores an extreme case of an “architecture machine” that handles a unique, ever changing and completely personalized problem of design. The project of the empowerment of the non-expert in design, is undertaken as the most extreme and challenging “exercise” within the Architecture Machine Group’s endeavors, able to reveal “the makings of architecture; the interfaces between people, machines, and the real world” and contribute in the overall group’s research.

What is particularly interesting in this article, is the fact that it clearly states a need, that had not been clarified until the writing of “Soft Architecture Machines”, to establish a specific set of features in the design-aids, according to whom they each time address. Weinzapfel makes an important distinction between YONA and programs such as ARCHIT or IMAGE [16] that either substitute the user (in the way that Negroponte earlier analyzed) or require skills that a novice could not possibly have.

The YONA Program
The YONA experiment lasted for 8 weeks and involved weekly meetings of a young couple that designed their own home that they would build and live in, with the Architecture-by-Yourself staff. The meetings’ main conclusion was that although the couple had a rich repertoire of evaluation criteria based on prior experience or desire, they encountered great difficulties in expressing those desires in the generation of a design. Based on this observation, Weinzapfel proposes that a software empowering non-expert to do design, would have to be structured on a step-by-step strategy offering assistance whenever the users would halt.

YONA implements Friedman’s main proposal to use linkages as the “backbones” of design, combining it with Negroponte’s call for a discrete consulting by the machine, that allows the user to discover the problems of his/her proposal and find ways to correct them. After the completion of this stage the linkages are replaced by bubbles (the FLATWRITER’s labels) and then shapes. Weinzapfel notes that Friedman’s approach decomposes the design problem, “not by abstract concepts of form and function, or by service spaces and areas served, but by the more tangible factors of room placement, connectivity, size, shape, and 3D form”. This ability to immediately visualize one’s design decisions and contemplate on their consequences is a highly educational process that deeply contributes in the idea of user empowerment.

As far as Negroponte’s initial considerations on the computer graphics part of the endeavor are concerned, Weinzapfel notes that user-machine communication is entirely graphical, using IMLAC dynamic displays and a Touch Sensitive Display tablet allowing users can manipulate objects on the screen by pointing at them with their fingers, instead of using the unpractical and inaccurate light pen that most of computer aided design programs deployed until then and thus eliminating “one of the more serious barriers between naive users and the machine”.

CONCLUSION
The above readings, constitute the fascinating narration of a series of systematic efforts to combine computer aided design with the idea of user participation in architecture. Apart from their historical interest and the admittedly entertaining character that the revisiting of early computational visions from the place of today’s digital world has, the comparative analysis of these studies is a very good opportunity for the extraction of diachronic concepts that can be the basis for contemporary contemplation in the same area.

Computer-aided ...
As far as the computer program design decisions are concerned, this reviews readings place particular emphasis in a user-machine interface that allows for “natural” and personalized communication. The issue of computer graphics and their strong influence in the way that an architectural idea is conceptualized and expressed is still a question of great importance. The expression of the user’s personal drawing idioms and the program’s adaptability to his/her “idiosyncrasies” is a demand that is equally applicable in contemporary computer aided design software development.

Another key point emphasized in different degrees in the above studies is the use of computer aids as educational tools, bringing non-experts in contact with the world of Design. The playful and tactile experience that transports the users in “Designland”, enabling them to acquire the skills to express their personal needs and desires is a very interesting direction.
that is currently completely neglected under the dominant tendency of a solely instrumental use of computer design aids.

What is more, the science-fictional exploration of artificial intelligence and man-machine interaction, proves a very fertile ground for the articulation of different communication models of high theoretical value. The idea of a non-defining, “soft” technology that is represented in the Design Amplifier, or the invention of a “neutral” and “objective” negotiation mechanism between local desires and global needs, are notable contributions in the philosophy of technology.

However, in all of the above readings, the machine is conceptualized as a compact entity, whose ways of operation remain obscure to the user. The communication happens in a higher level language, through a well designed interface. The unmodifiable character of the machine, that can in the best case intelligently adapt to the user’s input, creates the basis for a dialectic relationship that can support arguments and interruptions. Given the fact that nowadays technology does not longer carry the connotations of neutrality and purity that characterized its dawn, as well as an increasing demand for control of the tools and technological frameworks within which the user operates, we believe that the implications of a user programmable architecture machine could be a new area worth exploring.

...Participatory Design ...

One cannot ignore that apart from the contributions in the discourse about computer aided design the above presented studies, enriched also the area of participatory design with an alternative model that moved beyond the dominant practices of advocacy planning and proposed a “democratization” of design through immediate user participation. The “do-it-yourselfism” that they promoted, along with the transfer of the primary design responsibility to its users, who bear the risk of its failure, is a tendency that reemerges today under a different context.

However, probably carried away by the vision of the personal computer, as well as because of an ideological climate that promoted individualism as the counterpart of the oppressive generalizations of the past, the idea of the community is totally absent from these studies. The whole is conceptualized as an abstract set of external constraints. An issue that constitutes a challenging field of research is the incorporation of different scale collectivities in the above problematic and the investigation of the implications that this would have in the idea of participation and empowerment.

...Today?

The availability and accessibility of design software, the growing culture of “making” (or “hacking”) as a demand for product personalization, the reinforcement of the idea of collaboration through hardware and software online communities, along with growing concerns on the increasing alienation of architecture from its social connotations, bring the question of computer aided participatory design back to the surface, demanding for redefinitions and reformulations. The early studies in this area constitute valuable precedents indicating directions of thought or serving as bases for productive criticism and further study.

REFERENCES