Agency of Interactive Architecture in socio-technological relationship through Actor-Network Theory

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Abstract. With fast development of new technologies built environment transitioned from a silent background of activities performed by users to another participant of those activities. Agency of interactive architecture is based on interpretation of input data, like users' actions, their response to the spatial agency, data from environment or other actors, and changing its performance accordingly. Architectural components, environmental conditions and people are all treated as agents and closely correspond to Actor-Network Theory (ANT). This theory generally aims to reveal the complexities of socio-technological world. ANT incorporates a principle of generalized symmetry, it means that human and nonhuman (artifacts, organization structures, etc.) actors are incorporated into the same conceptual framework and assigned equal level of agency. By analysis of the agency of Interactive Architecture through ANT the paper provides insight on social role of this new emerging type of space and its influence on other participants on socio-technological relationship.

Keywords: Interactive architecture, Communication, Agency, Social, Actor-Network Theory.

1 Introduction

With fast development of new technologies built environment transitioned from a silent background of activities performed by users to another participant of those activities. Embedded computation allowed architecture to become intelligent and it gets smarter day after day with technological advance, it becomes interactive and gains agency. Architectural space now is able not to merely adapt to changing conditions, but to process information and react, observe and learn, communicate and make decisions. Agency of interactive architecture is based on interpretation of input data, like users' actions, their response to the spatial agency, data from environment or other actors, and changing its performance accordingly. Therefore interactive environment becomes an active participant in social relationship, communicating with users and learning, trying different modes of interaction and making decisions, constantly changing and having

its' attitude. Within the context of this research interactive space is considered as a participant of social relationship along with its uses through the Actor-Network theory constituting one common network in which both human and non-human actors have agency. (Fig. 1. Users and architecture communication scheme)

Interactivity essentially means that both people and buildings have agency, enabling the creation of conversations between the two in real-time. The main difference between responsive architecture and Interactive is the agency. Interactive means the dialogue between space and users/ environment/ forces where they both have agency enabling real time multiple loop dialogue while responsive environment gathers data and responds to it but has no agency. [1]

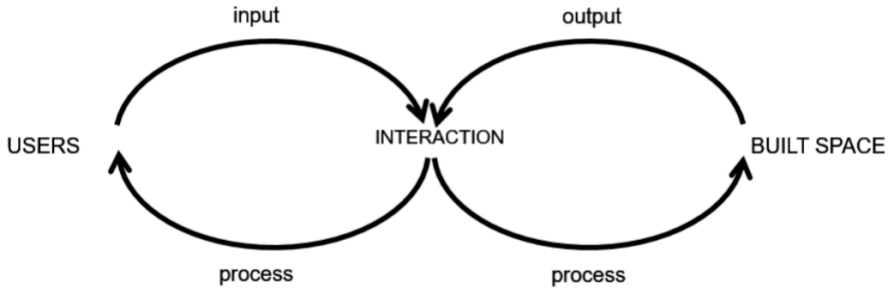

Fig. 1. Users and architecture communication scheme

2 Interactive architecture through Actor-Network Theory

This paper defines defining social role of Interactive architecture and explains how it interacts with users, what qualities are enabled by interactive behavior and how does it influence space perception by users, articulating the significance of bi-directional communication between society and smart spaces. While static architecture is able to perform one pre-defined function, interactive space accommodates different behaviors and therefore improves its' functional and social performance, allowing different uses and groups of users to use it in modes of communication. Instead of merely facilitating an event that happens inside, interactive space is a participant an event by itself. In this context Agency can be referred to as the soul or mind of architecture.[2] It's dead and frozen without ability to communicate and change in kinetic or digital manner, but it is alive and playful (in its own way) once it has agency and ability to perform. Interactive architecture is not just providing space for activities and facility for lifestyle, but influences it. It can be as a mirror, reflecting users' behavior, environmental factors and society, or a window to another experience, showing how the space acts on its' own. Or it is a double sided mirror allowing interactive environment to observe users and decide how to act in accordance with these observations. The key questions asked within the framework of this paper are:

• Interactive Architecture as means of shaping users behavior in space within the framework of Actor-Network theory

• Interactive Architecture as a participant of social relationship through Actor-Network theory

• Behavior of Interactive Architecture (Communication with users)

The main objective is to identify agency of Interactive Architecture in social relationship by addressing its role through Actor-Network Theory. (Fig. 2. Network scheme)

What influence does Interactive architecture have in social relationship and how does it shape users behavior and space perception? The role of Interactive Architecture in social relationship can be addressed through Actor-Network Theory (ANT). ANT frames relationship between people and Interactive space as a system that contains components of human and non-human origins, all components are socially constructed and society shaping. All components of a system interact with each other and contribute to the common system goal. Within the context of this research non-human components are represented by interactive spaces, experiences or interactive architectural components that have agency, forming a system or a network that facilitates their social communication. As Thomas P. Hughes argues while non-human components are generally aimed at problem solving functions, human components mostly act as providers of feedback in order to establish connection between the system performance and the system goal, shaping its behavior and determining its agency. Degree of actors' autonomy or freedom within a system relies on the system complexity and goal and differs from on case to another. [3]

The agency of Interactive space in social relationship can be defined through ANT as it proposes amalgamation of human and non-human participants of this relationship, hence all of the participants influence each other. Users and interactive space constitute one social network being constantly aware of each other establishing bi-directional communication.

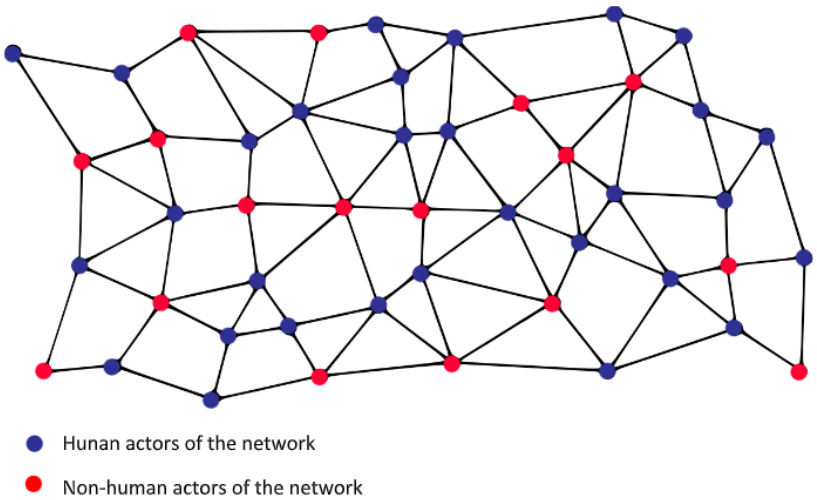

Fig. 2. Network scheme

3 Cybernetic perspective

Since very early in the development of interactive architecture as a field, the description of a new world where buildings have evolved alongside a futuristic society to assume new functional and social roles has populated the imagination of architects. This expectation is justified by two reasons: first, because it is known that technology has the potential to catalyze profound cultural transformations; second, because interactive architecture carries the potential to cause unprecedented shift to buildings' capabilities, which have otherwise evolved at a very conservative pace. [4]

When adopting a cybernetic perspective, the idea of architectural agency can be appreciated even more comprehensively. Assuming every interactive architecture system is expected to have some sort of internal goal, without which feedback structures are not conceivable, then every single interactive architecture system will also display some degree of intrinsic agency, even if it does not involve complete autonomy or intelligence. Thus, if every architecture or architectural element can manifest extrinsic agency (in Bruno Latour's conception of the term), equivalently every interactive architecture setting can also manifest intrinsic agency. [5]

Interactive architecture's initial relation with the problem of inhabitant agency is explained, to large extent, by its foundation in cybernetics. Gordon Pask, a main proponent of the second generation of cyberneticians, introduced the relevance of feedback, systems design, and under specification in architecture. Through systems thinking, interactive architecture would allow for buildings to become components of empowering environments by integrating the human user as part of a larger control loop. Pask explicitly claimed that, in interactive architecture, "the designer is no longer conceived as the authoritative controller of the final product;" instead, "an environment should allow users to take a bottom up role in configuring their surroundings in a malleable way." Usman Haque (2007) also argued that applying Pask's ideas to architecture "is about designing tools that people themselves may use to construct — in the widest sense of the word — their environments and as a result build their own sense of agency." Authors such as Negroponte (1975) have also extensively framed interactive architecture, or computing enabled environments, primarily concerned with freeing the user from the paternalistic figure of the architect by instead providing agency and responsiveness.

The extensive discussion around participatory design in architecture since the 1960s proves that this question of who should control the formation of the built environment is an important concern of architecture. Instead of focusing on anticipatory demands, exploring inhabitant agency and empowerment in IA may help address immediate challenges faced by designers. [6]

3.1 First order cybernetics

Decades before Cedric Price and Gordon Pask, the term "Cybernetics" was defined by Norbert Wiener in 1940s as "science of control and communication in the animal and the machine, organisms and mechanisms." Cybernetics as the field started to evolve into what we know now almost 20 years later when it embraced cognitive science and

artificial intelligence with information and communication networks of post-industrial world. Wiener also suggested neglecting differences between living organisms and machines, arising from the fact that both entities should be considered as self-regulating machines, controlling entropy through feedback, meaning learning from experience and correcting future behavior based on previous operations.

Nicolas Negroponte: wrote about intelligent environment that has agency to respond to users' needs, make decisions and execute functions. (Fig. 3. First order cybernetic scheme)

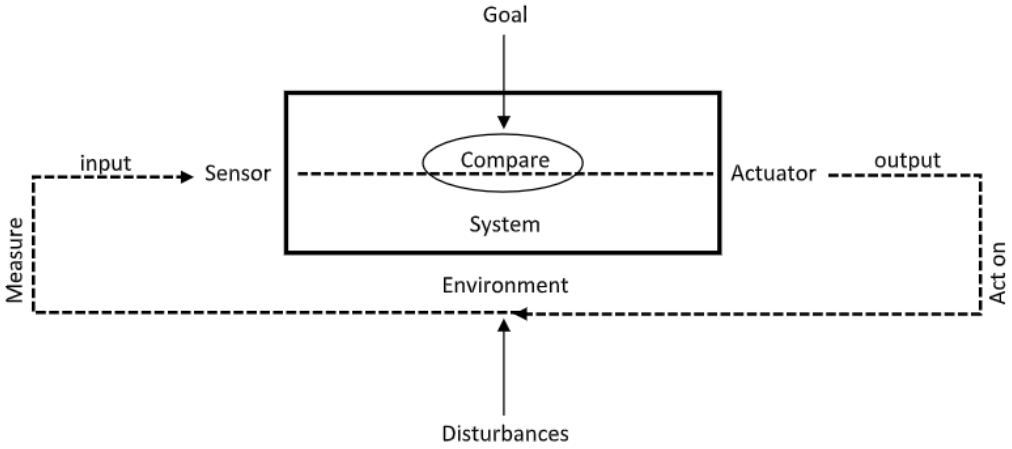

Fig. 3. First order cybernetic scheme

3.2 Second order cybernetics

The order of the system is maintained not by interacting with the environment, as it was for the first order, the system is closed and autonomous. It provided insight to self-organization, emergence, learning and conversational interaction in systems – either artificial, social or biological. (Fig. 4. Second order cybernetic scheme)

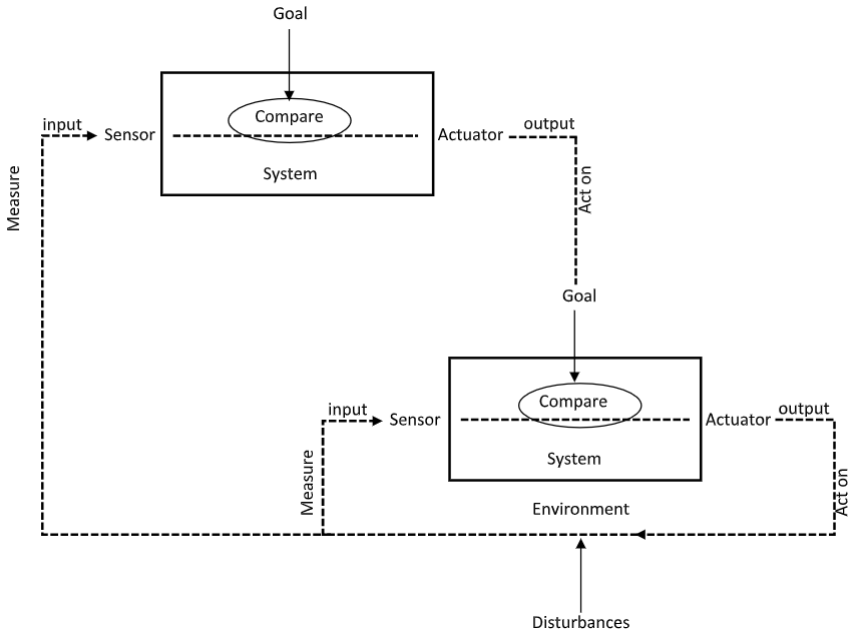

Fig. 4. Second order cybernetic scheme

3.3 Third order cybernetics

The application of second order cybernetics to social systems to explain their functioning has become commonplace in the students of cybernetics, sociology and complexity. Social systems are displayed by the concept of autopoesis, pitched by Maturana and Varela although it describes biological process and can't be used in social self-organization directly. It's also stated that generally application of biological principles on social structures doesn't allow to address individual elements as system components durectly. As the consequence of this approach there emerged a number of theories of society that can't explain how individuals reproduce social structures and how the sociality is reproduced by them.

The subject of cognition is the bridge that unites autopoietic systems and social systems, because the former are systems capable of it, while the latter are the product of socialization, which is consequence of cognition. Maturana (2012) understands cognitive systems as those whose organization defines a domain of interactions in which it can act with relevance to the maintenance of itself, and the process of cognition is the actual (inductive) acting or behaving in the domain. Living systems are cognitive systems, and living as a process is a process of cognition. This statement is valid for all organisms, with and without nervous system. [4]

Considering all the above, cognition is the processing of information made by an autopoietic system in its interaction with what surrounds it (environment and other beings) with the purpose of sustaining itself. This will be called lower cognition.

Maturana distinguishes a set of degrees when it comes to the interactions that a system can have, he states three, each of which is contained in the preceding one:

• Cognitive domain: Comprises all the interactions of the organism and can be enlarged by adding new modes of interaction.

• Domain of interactions: Set of interactions into which an entity can enter.

• Domain of relations: Set interactions through the observer in which an entity can be observed. [7]

One becomes an observer by "recursively generating representations of our interactions, and by interacting with several representations simultaneously we generate relations with the representations of which we can then interact and repeat this process recursively". An observer can define himself as an entity by identifying his own domain of interactions and yet remain as an observer if he treats them as independent entities. An entity can achieve self-observation by means of repeated self-description and self-consciousness by means of self-observation (Maturana and Varela, 2012). Self-consciousness is the point of transition between lower cognition (which pertains second cybernetics) and that which belongs to human beings (which is the object of study of what will be called fourth order cybernetics), which will be called higher cognition. Therefore when a system becomes fully self-conscious and observes itself, it can set its own purpose, which is tempered by the interaction with the environment. A self-observing system - unlike other cognitive systems - is both teleonomical and teleological.

Self-consciousness is a consensual phenomenon (not a biologic one) which comes from an independent domain of interactions from self-orienting behavior and lies entirely in the linguistic domain and requires a minimum of two interacting organisms with similar domains of interactions. It is both an interaction and a communication because these interrelated behaviors bring forth a cooperative system of consensual interactions in which the emerging conduct of the two organisms irrelevant for both. [8]

4 Methodology

How does interactive space communicate learn to influence users' behaviour?
By using learning mechanism (such as distributed adaptive control) smart environments can learn effective cues to influence users' behaviour and guide them through space and set preferred directions. Truly interactive intelligent space incorporates a bi-directional symbiotic approach to human-environment communication, being able to affect users' behaviour as well as be affected.

4.1 Language of communication between environment and users

Instead of using gesture or voice based language it could use non-verbal language of ambience alteration like sound and light as output and tracking as input. These means of communication are used in order to avoid antropomorphization of the space as it would happen with utilizing language-based features like spoken or written words.

How do the environment and users learn to influence each other's behaviour within the framework of Actor-Network theory

"Intelligence" in this context refers to the perception of space as the defining capacity of users, but it is the smart ability that is now extended in its efficacy by the sensibilities of affect. Figuring the Human in Intelligent Space relates to, arises from, or deliberately influences emotions.

Users are naturally active learners and explorers if they have a proper motivation. The major part of interactive space behaviour depends on users' performance or other external stimuli. Interactive environment can provide cues for visitors on how to act within it, a target to move towards, possible routes, options of space use. The space tracks users and assesses their responsiveness to cues from the space, learning how to communicate effectively. In case of distributed adaptive control (DAC) the learning scheme is based on two simple rules of trial and error learning: if something works, do it again; otherwise try something else at random.

4.2 Affective design

Affective refers to emotional, but may, perhaps usefully, be confused with effective". [9] Emotion is another component, then, needed for effective rationality. More generally, discourses of affective computing evidence some shared starting assumptions: "Affect" comprises a distinguishable domain of cognition that can be analysed into universal, component parts. Affect is the expression of an underlying emotional "state." Affective interaction can be achieved through the replication of behaviours understood to comprise it, made up of units assembled into a catalogue of affective expressions, productions, recognitions, and normative responses. Emotional states and their affective expression can be understood in terms of their (evolutionary) utility, as a kind of primal but still functional ancestor of contemporary reason.[10]

4.3 Artificial intelligence of interactive space

Since Interactive architectural space has agency of its' own it certainly also has the intelligence of its' own. Conscious' spaces become active members of society, understanding the world around them, sharing a common goal, a goal that the machine understands its meaning hence acquired initiative that drives it endeavour to search for the answers and ways of performing.

Intelligent spaces within the framework of this research share common understanding of the world with users, developing knowledge and understandings of

the world through interactions between them and the physical environment, responding differently to interactions with the context.

5 Interactive architecture in social relationship

The built environment organizes social processes of interaction and plays a role in establishment and stabilization of social order. It also involves ownership, spatial exclusion and demarcation by means of physical barriers with corresponding rights of access. The built environment structures social situations and provides orientation for the participants of the social processes thus organized, who then find their place of their own accord. It communicates the social structure.

Urban spaces, both interior and exterior, are always designed spaces and also always function as a form of communication: They inform users about the types of interaction and the types of participants they can expect to find there and thus provide an initial, framing definition of the situations to be expected. Communication can hardly take place without a preceding definition of the situation.

Accordingly, a well-positioned and well-articulated space is a communication, namely an invitation to participate in a specific communicative situation that, like any communication, can be accepted or rejected. Should the communication be accepted, communicated by entering the space, the space functions as a common premise of all participants and all further communication that subsequently takes place in this context.[11]

Together with the other design disciplines – including urban design but not regional or urban planning – architecture forms a unified discourse, a function system in the sense of sociologist Niklas Luhmann (cf. Niklas Luhmann, “The Society of Society”), with exclusive universal competence in terms of the physiognomy of the total built environment and the world of artefacts. Architecture has to be linked to other environments, analogue as well as digital. For instance, the building is crossed with another location. Interestingly, the aesthetic experience may be collective as well as individual. By implementing multimedia approach and designing a new type of interface that offers selective worthwhile exchange, the new type of spatial extensibility into another dimension. Architecture now accommodates not just static construction components, but moving situations. In connection with other systems' networks, architecture becomes reprogrammable in meaning that the buildings gain ability to play an important cultural and social role throughout longer period within their life cycle. Ability to be updated is not a question of adaptation to new functions anymore, but the essential component in architectonic performance of static object. [12]

Architecture now can reflect the social performance in multiple ways:

- it can change its shape according to users desire
- it can adapt itself to different types of activities
- it can be linked to remote device or other environment (virtual or physical)
- it can become a possible modality of Network activity

With these new abilities architecture now can be updated in order to communicate with the society on qualitatively new level. Architecture becomes a form of time

transmission. This time can be filled with any content desired, so the architecture now offers not just the space, but also the time and the information. "The result is the rise of Digital Gothic", as Kas Oosterhuis puts it. [13]

6 Conclusion

Since communication of people and interactive environment is bi-directional and implies that both people and building components have agency and impact each other they both do act in accordance with their further activities and considering the response they received previously. Interactive environment that triggers various senses is proven to be immersive and stimulate further communication. Using unique space qualities and tangible means of interactive architecture users can be guided through space and engaged into various activities as the part of communication with the space. Users are invited to explore the space and what it does, they are offered to perform certain tasks in order to continue this communication and during this process they can be brought through different modes of space cognition requiring their active or passive participation in this dialogue. [14]

Interaction of users and interactive space is usually considered on individual level and targeted on communication of one person with the space. Within the context of this research interactive architecture communicates not only with individuals but with groups of people becoming a part of their social relationship. Both individuals and groups of people can be considered as actors of one network depending on the mode of interaction and its' final goal. Space without interactive qualities was always a facilitator of communication between people providing a background for their relationship and letting them to pass through it, accommodating them and serving a certain function. Interactive properties allow the space to take part in social relationship, becoming a part of it and being the driving force of their communication with each other within the space and with the space itself. Interactive space does not only provide unique experience but can also create situations engaging users and groups of users in common activities, requiring them to act independently or in groups. Space and users communicate in real time, defining further modes of this interaction and shaping the experience. Social influence of interactive space yet has to be analyzed within the framework of ANT in terms of communication with users on different levels and how does this communication benefit the society. [15]

Interactive architecture has multiple qualities that assigns it as the new type of built environment such as ability to communicate with users providing unique space experience. Comparative analysis includes exploring how interactive environment can understand users and interact with them providing immersion into this communication and committing to its' rules. It refers to learning mechanisms of interactive architecture on one hand and implementation of this information in defining its' behavior on the other hand. It refers to affective design and focuses on building the most comprehensive engagement of users and space, learning their behavior patterns and utilizing this analysis to foster communication.[16] The space acts as alive being and it invites users to communicate, observing their response and changing its' performance accordingly.

In behavioristic perspective interactive space can has various modes of communication determined by its function and position within the network of human and non-human actors. It depends on the rules of communication and heavily relies on response of the users and their desired degree of engagement. The ultimate goal of this interaction is to provide certain experience while allowing all users to feel comfortable within it and communicate, therefore continuous analysis of users' behavior allows the building to understand them and create beneficial and pleasant relationship. [17]

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