From Digitized Systemization to New Era of Autonomous Materials Facilitation in Architectural Design and Actuation

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Abstract. Based on the architectural approach of Human Acceptability towards built environments, the functionalization of advanced and renewable materials through part-autonomy to general systemization and structure-making could be considered as one of "the key factors" in sustainability. The contemporary states of material automation and autonomy methods are passed through several featuring orders, but in general, they are still not qualified to be considered as domesticated aspects of dealing with the natural resources through the build and construction orders in "the 4th industrial revolution". This is the main problem of this paper and so, it will clarify the modeling, individual processing, and the emergence of such issues to rich the humanistic acceptability and interaction "as supportive aspects". Towards that, this paper approaches some of the basic methods of contemporary facilitation, formulation, and reformulation of enhanced materials and natural resources through the architectural domains to clarify the role of industry-architecture relation, which at the first look of the human-centered set make challenges for active/operative systemization. So, such a procedure also needs to provide a better understanding of the contemporary potentials of sustainable applied practices furthermore. In addition, the embodied intelligence of respondent materials would be characterized as a cornerstone of structural control and micro/nanoelectromechanical systems of the upcoming era of individual autonomy, which would be covered in this paper as a new method of nature-based logics classification. Through four featural points of modeling technics, beauty characterization state in sustainable applications of post-digitalism, bio-based logic as the principle of additive design, and the smart processing as basic of functionalization of additive design, this paper provides a primary insight towards the faster, more efficient and effective solutions of fully autonomous driven of sustainable actuation and design prospects architecturally.

Keywords: Autonomous materials intelligence · Bio-based logic · Ontological genotype

1 Introduction

The first two decades of the 21st century were the in-between time zone of construction materials and the methodology of their applicating as enhancement processes between

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two main digital and post-digital eras of general actuation technologies. These two integrational periods provide effective potentials for the architectural design, technologies, fabrication, spatial actuation, and practices to build a contemporary platform of material utilization technologies and new properties understandings through the constructional orders. As clarification of the word 'potential' in this matter, Cambridge dictionary defines the term as (possible when the necessary conditions exist), or (someone's or something's ability to develop, achieve, or succeed), or (possible but not yet achieved), or (able to develop into something in the future when the necessary conditions exist), or (the possibility of something developing or happening in a particular way), and (natural qualities or abilities that mean that someone or something may or should succeed or achieve something) [1].

The outcomes of post digitalism as a new set of individual potentialities of actuation needed sort of appropriate featuring and guidelines to be raised as applicable methodologies in the architectural domains. The experimental phase of aggregative processing reveals the advanced key aspect of controlling both expressive and operative divisions of individuality through the productional series of architectural effects. This paper explains the main approaches those together edit the structure of contemporary automation, as gradational progress from the ordinary type, to the combined and the autonomous ones by considering the role of nature in papering the shared logic between them. Also, provide a primitive insight towards the aspect of adapting the independency as a key factor for the futuristic prospect of architectural practices and facilitating the advanced intellectual sense of nature as its base for more fundamental investments.

2 Modeling of Posthuman Beauty Due to Ontological Factor Sample

Based on what is known as the model of a thing, the model-making was for representational order, rather than revealing the potentials, abilities or dysfunctionality, or disorder. The Model Ontology division of the theoretical foundation demonstrates the importance of positioning the true representation of the final object or the model by considering its own true-scale for projecting its real nature and manner in order to be efficiently invested [2]. As it is known, until the end of the middle ages in Europe, the practitioners were using the ancient Greek-based method of preparing a minimized model, that known at that periods as '*paradeigmata*', in order to represent their final piece or prototype or object as 'documentation of the contractual consideration' procedure. Also, we can mention one of the earlier model-builders, those not only distinguished because of their conceptual manifestations for the architectural field, but for their craft or 'techne' of processing, Vitruvius, the most known through the history of architecture. Also, Alberti was using the modeling for explaining the ontology of the system through the simulation of the three-dimensional, strength of the proposed structure and related solidity form as mass objecting of the prototype of the project as possible as he and the technology enabled for. So, the mentioned examples were just representing the transitional stage from the graphical representation and individuality of analyzing of the next stage of the enabling the faster and easier understudying of the next stage of the properties and potentials, but still with wide range of individuality and propositional sort of scaling,

performing, resisting, detailing and the most important aspect of using the real and the same amount and covering area and combination of the determined materials [2].

The model in it prototyped phase, that just delivering some unrevealed prospects of the final object, system or project has an alluring nature to what is wanted and unrelated to the fact potentialities, that mostly overshadowing the recipient. In this matter, architects must under title the finalized models of their project as a 'preliminary object', and not a final one. For the real and efficient validation and analyze, as responsible way for true representation of the primary morphology of the project and also as Massimo Scolari states about that; they are "miniature isomorph of the building" in their scale and properties, not as final set of the gained potentialities [2]. But the phase of the included beauty of the order through faster achievement of all aspects of the final object is introduced via simulation technique which gives us the benefits as;

1. The easier capability of dealing with, because of smallness of the scale,
2. It provides variety of possibilities of fabricating and assembling parts, junctions and details, depending on the variety of material and methods.

Researchers saw this as emergence of new forms of (posthuman beauty), when architecture moves the locus of its experimentation from the authority of the abstract drawing and expressions of truth in materials and assembly to the speculative reality of the model [2].

According to the explained sight of (ontological analyzation), the resulted prototype or object as model aimed to challenge the recipient mind in order to be able to see images and differentiate between a toy and real model. That is because of the difference and the patchiness of the used materials in construction (as real object) or on the surfaces (as drawing), those leading to the forming patterns according to their properties but not on the same quantity and even quality of designed for the final and on the ground object. Thus, the result of simulating object or prototype will not prove any objective performance, because of its absence on the ground as existence of reality, and the mimicry of the final order, and could only counted as alteration of individuality of some limited process towards the reality. Yet in this course, the (ontology) of the individual model or prototypes would demonstrate some new aspects, even if the prototype is designed to the proper human scale for revealing some techniques of operational orders or constructional methods as; Setting the partial and spatial relationship as alterative scaling of needed order, revealing new set of functional and spatial aesthetics, and enabling for some unusual sorts of physical editing and dealing with for both partial and comprehensive manner of manufacturing, fabricating and assembling and remaining under the term of representational aspect of the modeling that not necessarily giving true advantages.

Here, the individual roles of both joints and parts of the model are taking place for revealing strange manner of beauty via the facilitating the 'meta-seams' method of material or junction, that leads to the 'tectonically phase' of the expressed beauty as affective aspect, and the unexpected functioning of connection via the use of 'super-components' of the beauty, that could charm the recipient by the unexpected state. The researchers see that mentioned means of achieving the state of the beauty, would be accessible by considering the harmony between the 'true functioning' and operating according to the exact scale of manufacturing or fabrication that designed for, in order

to develop the optimum results and demonstrating 'the difference between the fact and fiction', which refers also to the essence of necessity and the shading by simulative projection and propositions.

3 Smart Processing of Additive Design and Manufacture

The contemporary architectural disciplines of automation and individual programming have been characterized by the algorithmic manner of intellectual enrolment. This manner is considered as basic analytic procedures of training software and machine learning as well. According to the need of enhancing the range of accuracy in final actuation and its impact, the utilized material in machine learning order, which depends on software or preprogramming of material training, leads to advance accuracy and deeper insight of problem deduction, analysis, and solution-makings and finally actuate as much as properly [3]. As explained in Fig. 1 the developed by Benjamin Jennett and Kenneth Cheung example of versatile and generative phase of digital processing and production at MIT and NASA, BILL-E, distribute robots those are able to build, inspect and edit discrete lattice structures. Compared to continuous fabrication methods such as 3D printing, this approach offers the possibility to adapt, maintain and repair structures in real-time [3].

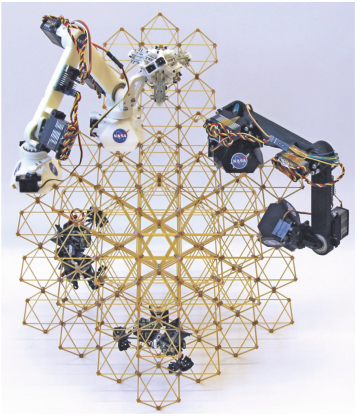

Fig. 1. MIT Center for Bits and Atoms and NASA Ames Research Center, BILL-E robotic platform, 2017 [4].

Also, for controlling the final properties of the produced model, discreteness provides the access to the ability to scale mass-deformation by the computational process as (what we saw in term of architectural mereology of processing and conducting of parts). The term discrete in computational design and processing reveals the 'key-aspect' of both autonomously automotive optimization of the quality of the architectural production. Here, the role of the part in the structure of the model passes through the historical mean of element towards the unite, then to the cell as contemporary 3D or even 4D printed matter, and eventually to the data, bits or sign as Emmanuelle Chiapone Piriou

explains the historical evaluation of facilitating the discreteness of the parts in architecture. Thus, the architectural state of 21st century's aesthetics are no longer referring only to the optimization and sophistication of production, but paving the way to reducing the amount of humanistic efforts and costs and directing them more to the social benefits by automation and organization of materials and systems, as the raised practicing platform.

4 Emerging of Post-digital Potentialities with the Concept of Beauty

Continuing the theoretical approach towards the achievement of optimization of the architectural order of the contemporary materials and system of the early 21st century through post digitalism, the term of beauty is also linked to the act of control of artificial intelligence mechanism of transporting and transferring big data, in order to enhance the actuation of the functional situation of the final architectural products [5]. Depending on the fundamental aspect of ontology and discreteness of finalizing a system or a model for architectural and also functionally related to operating and effect, which are another aspects of basically rooted to the essence of reality for both mentioned aspects have to be projected as (scale and factor of the beauty) through the (potentiality of programming process). This means that the form and space needed with their aesthetical characterization might be uploaded as programmed order through the construction materials.

According to the philosopher Max Bense in 1960, the methodology of 'programming the beauty' in order to function beyond the emergence of qualities of materials and technologies, achieved at that period a wide and open-ended prospect for evaluation and development, the difference between the substances of both designed and constructed terms of the beauty becomes obviously clear through the outcomes. Thus, in order to follow the update of the characterization of the mean, the state of beauty demonstrates raised constants, those represent the aesthetics of scaling the range of impacts and capabilities, and so the state of beauty which was affecting the individual set of the understanding. Due to that, it becomes the state of reality that affects the explorational phase of the recipient's consciousness according to the physical and objective investment of properties of the architectural system. By considering Bense's sight to the contemporary state of the beauty and its relation to the technological integrations of functioning and facilitating the orders, as he expressed as: "the concept of beauty is losing in substance, but gaining in function", and Aristotle's description of the quality towards the quantity of the beauty and its impact by considering the discreetness in sorting each item for assessing the impact of the proportional relationship between them as a mechanism of production and operation, so the act of setting the beauty range depends on the ontological aspect in the physical process, which reveals the quality of the production, while the discreteness reveals the quantity of the order and the advantages of every single property of the entities [5], such as; Segments, Vortexes, Surface or mediums, and needed time of accomplishment. Those represent the pillars of raised technology of programming materials through the 4D printing technology, and basic element of programming and tangibly functioning and self-actuating the medium of producing (the new concept of the beauty). As well as the quantity of the order here, the quality phase contains discrete features through its own medium of the process [5], such as; The nature of performing

and actuation potentials, the range of 'effect on' and 'affect by' via the impacting of functioning, permanent method of operating through the mechanism of the system, and state of patchiness towards the emerged conditions.

So, the new approach of 'assessing the beauty' according to both factors of (quality and quantity) have temporary and permanent features due to the mechanism and enhancement of each factor. The state of beauty here refers to the superior effect and the depth of effect according to the immediate impression that received by the human desire achievement, not only as concept or individuals, but as real novel and unexpectable operating and actuation on the ground due to optimization of the process. According to [5], the beauty aspect demonstrates the state of (deep super-quality) of its order that could be described as the ability to operate in the numerous medium of parametric aspects, such as the special and geometrical aspects as the transferable actuator, due to the memorization and autonomously responding potentials, as a new aesthetics of contemporary version of engaging with the act and respond term of design. Its volatile nature would allow this aesthetic system to interact with programmatic, structural, ecological, or contextual frameworks and inform them. Also, the parametrical mediums and their related entities are playing the main role in directing the comprehensive mechanism of actuating the system by the manipulation, stimulation, and also the direct informing of the special unite or part of the system to characterize the aggregative manner of operation by combining every single discrete mechanism together.

4.1 The Beauty in Post-digitalism and Bio-Digital Based Sustainability

As contemporary pre-planning characteristic order of qualifying the design and operation approach of architectural practice, and facilitating such order on both individual and urban scales of, the so-called 'blue-green planning' reveals efficiency in dealing and processing the climate change problem and other special and functional aspects those based on the architectural role of the system. This prospect of confronting the contemporary challenges of the early 21st century via the firm framework of providing real and true answering or problem-solving of the order, based mainly on two incorporated domains of (contemporary bio and digital senses), and actuating new aesthetics on this matter as well [6]. Through the blue-green planning the involved practicians of the architectural field which targeted the (re-greening state of architectural footprint) by sanitizing the ecosystem of the design and production order, to reach the endurance of modernity, inspired by bacteriological aspects and principles of controlling of sanitate actuation to produce a harmonical medium of live-beings, special use, and consumption. Here, the general concept of architectural fabrication, accumulation, formulation production, and even interaction and response paradigms are wider than the digital manner of individual actuation, ordering, and synthetical methodologies of physical facilitating of mass-material. The new approach demonstrates the 'deep efficiency', and 'system values' of emerging the biological scope of investing for accuracy and production along with the last achievements of the early 21st century's period of post-digital state, in order to prepare a new vision of (self-automotive manner of formulation and formation of natural patterns) [6], those crucially guide special and function order on the micro-scale as well ae the humanistic-scale of architectural order through magnifying the range of actuation via the same concept and principles. So, those principles on their new scale

of functioning could not be considered as linear procedures, and also reveal another division of processing the composition of 'bio-based feedback strategy' of contemporary material science and the architectural domain of design and operation. According to that, the state of independence here would be characterized as another 'non-human based strategy' of production and critical controlling of both ecological and spatial systems and would encourage the role and importance of nature, as (essential aesthetic guide) to the process till getting the final enhanced function.

Also, this approach considers the 'known as west material and pollution' as another variable of dealing and feeding the productional prosses and also turning them into new materials and nutrients as 'main resources' for continuing the order at others. So, this methodology of engaging with nature and the order has the potentiality of being facilitated on both scales of urban and individual or singular state of the architectural production, according to mentioned properties and frameworks of its conceptual division. From this perspective (ecoLogicStudio's bio-digital architectures) in 2018 promoted a new urban aesthetic centered around a novel appreciation for the micro-scale of bacteria as well as other forms of non-human intelligence [6]. Here, the new vision of formation and actuation establishes a new and prospected state of considering bio-based aesthetics as the essential root of culture for living and production through architecture. Also, revealing new sort of impacts identification of people as 'bio-citizenship'. Towards that, ecoLogicStudio in 2012 and Xeno Derma (as a research project) in corporation with Urban Morphogenesis Lab are studied experimental, spatial, and functional examples of this approach (Fig. 2).

Fig. 2. Interior and Exterior views of Cyber-gardeners ecoLogicStudio, HORTUS XL Astaxanthin.g, Centre Pompidou, Paris, 2019 [6].

5 Conclusions

The post-digital era of processing data and informative ruling of manifestations, reveals a new typology of dealing with the natural and artificial mechanisms of material activation.

This leads to adopting a new manner of classification and programming the orders as a more efficient technological approach, which directs the contemporary architectural state of practice to an extraordinary level of procedural understandings and controlling the production of the beauty and its impacts.

As the result, the procedure of preparing new aesthetics for the upcoming era of architectural practices, those based on mass-production and autonomy would remark new featural points toward guiding the suitability of built environment outcomes and paving the way for a higher reliance on material individual empowerment in forward.

Also, on the systemization scale of the next stages of the sustainable approach of advanced material actuation, the unseen beauty of potent codes beyond nature is riching the wider range of controlling the state of intelligence building of any artificial structures as the closest norm of providing efficiency of material activation due to human desire for more sufficient interactions.

In addition, this type of active norm are giving a deeper connection with the ontological aspect of material actuation for riching the optimum programmed for functionalization.

References

1. C.E. Corpus: Cambridge Dictionary, 21 May 2019. https://dictionary.cambridge.org/dictionary/english/potential
2. Wiscombe, T.: A specific theory of models: the posthuman beauty of weird scales, snowglobes and supercomponents. Arch. Des. AD **89**(5), 80–89 (2019)
3. Retsin, G.: Special issue: discrete: reappraising the digital in architecture. Arch. Des. AD **89**(2), 7–13 (2019)
4. Costa, A., Abdel-Rahman, A., Jenett, B., Gershenfeld, N., Kostitsyna, I., Cheung, K.: Algorithmic approaches to reconfigurable assembly systems. In: IEEE Aerospace Conference (2019)
5. Rutzinger, S., Schinegger, K.: Deep immediacy: programming beauty. Arch. Des. AD **89**(5), 98–103 (2019)
6. Pasquero, C., Poletto, M.: Beauty as ecological intelligence: bio-digital aesthetics as a value system of post-anthropocene architecture. Arch. Des. AD **89**(5), 58–65 (2019)