Algorithms as Archetypes
The latent effects of AI to the creative process of architectural design

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1. Introduction

The mediums to communicate thoughts have always influenced architecture as a creative discipline. Although the connection between ideas and physical forms varied throughout the epochs. Arturo Tedeschi sketches the development as follows: Architects have drawn plans before building since the Renaissance, when Alberti first called for a difference between the designer and the builder, thus architecture and mere construction. Drawings have been the architect's medium to organize ideas, resources, space, etc. and represent the architects' faculty to predict design outcomes. As methods of representation have evolved, new styles have emerged. Tools such as perspective in the Renaissance and projective geometry in Modernism have marked leaps forward in design. However, these tools have been dependent on a stable set of instruments for centuries: such as paper, drawing utensils, ruler and the compass. In this model each creative act is translated into a geometric alphabet by gestures which establish a direct link between the idea and the sign (Tedeschi, 2014).

Understanding how today's creative processes are influenced by computation, this paper builds on the relationship of algorithms, archetypes and architecture in relation to visualization as formal expression of the idea. How the relationship of the archetype and the architectural artifact alters due to computational design or due to the application of Artificial Intelligence as a design tool. The framework of the examination is the linear design process born in the Renaissance mindset, such as concept - communication and creation, where communication is understood as a connection between the sender and the receiver. As Figure 1 illustrates the connection of Archetype, Architecture and Algorithm this paper argues the importance of visualisation in different forms of expression, showing how algorithm based visualisation is related to archetypes. (Fig.1.) Archetype representing the origin of ideas, architecture the physical embodiment of a certain mental image, communicated through models (like drawings and often standardised notations) and algorithm as a way of communication. Expressing an archetype in algorithms is the least visually phrased form of information, since visual representation is less meaningful for computers, then humans. Finally, the relationship between algorithms and architecture is defined by rules, where the role of visualisation is increasing in order to realise the architectural form.
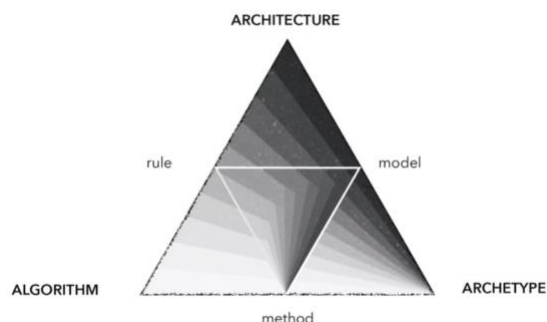

Figure 1. 3A – the synthesis of the Algorithm, the Archetype and Architecture in relation to the importance of vision and the three ways of creation. Melinda Bognar, 2020

2. Design

The design process traditionally involves the synthesization of the circumstances, such as the possible usage of the space, the behavior of the users along with the currently available resources, like construction materials, fabrication tools and labor. In this process Artificial Intelligence not only helps to harmonize all the elements, but also assists to communicate the ideas explicitly by algorithms.

The three related notions connected through the process are the original Jungian understanding of the archetype, algorithms as the scientific embodiment of the idea, and architecture as the physical materialization of the thought. The synthesis of these three elements appears through the transmission of forms, as rule, model and method. (Fig.2.) In terms of communication the ideas manifested in the innate picture of the sender and receiver becomes more unequivocal by transmitting images, and the most clear by transmitting algorithmic expressions. In this case rules refer to verbal communication with wide space for the fantasy, models refer to visual communication, where the message is more clear, and method refer to algorithmic expressions, when the meaning is completely unambiguous.
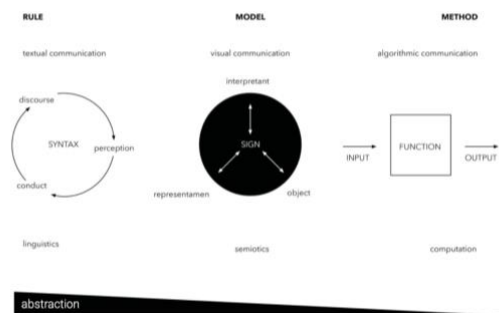

Figure 2. Relation of rule-model-method. Melinda Bognar, 2020

Digital strongly influences how architects think about the physical, the material world. Some think that digitalisation only affects processes that we already know and makes them more effective and automates operations. Meanwhile, others argue that digital technologies allow us to create something unforeseen. Computers offer a new perspective on things, different to how we looked at the world before. "The main challenge does not lie in mastering computational design techniques, but rather in acculturating a mode of computational design thinking." (Menges, 2011) Advanced design thinking is fostered by the opportunities concealed within Artificial Intelligence (AI).

3. AI

After World War II, a second modernism emerged in architecture, an attempt, in architectural scholar Joan Ockman's words, "to transform architecture from a 'soft' aesthetic discipline into a 'hard,' objectively verifiable field of design expertise." Architectural thought was influenced by linguistic, computational, mediatic, cybernetic, and other urban and behavioral models, as well as systems-based and artificial intelligence theories. (Dutta, 2013) In the 1950s and 1960s, there was a desire to "scientise" design. Buckminster Fuller declared a "World Design Science Decade" beginning in 1965. (Fischer and Herr, 2019)

Algorithms, primarily a notion of mathematics, which refers to a set of rules to be followed in order to solve a problem, are the fundamental means of scientisation. This paper examines the borderlines between the computable and incomputable and asks the question: is archetype computable?

Artificial Intelligence (AI) currently seems to contribute to this scientific design approach. Having its roots in the logician understanding of the world, and starting with modeling biological neurons, AI quickly became a calculation-based science with promising results. However, the question of computing dynamic-systems is still open. Examining AI as the most advanced manifestation of architectural computing will present the current approach to the archetype.

The possible roles of AI in architecture are endless and much segregated today; hence we need a methodology to systematise which branch can be best applied in which field of architecture. In order to position the possible roles of AI in architecture, it is crucial to see the nature of architectural design and how digitalisation contributes to its expression.

As a starting point this paper takes the design process based on the industrial workflow, as a simplified three stage course of concept, communication and creation. Where the conceptual phase is the period when the innate ideas of the designer based on the universal archetypes synthesizes. Communication is the stage where the ideas through the given medium (such as paper or computer) are being communicated towards the receiver, the client or the construction workers. And finally the creation phase when the plan takes the form of the building.

4. Allotropes of Archetypes

This section introduces the basic concepts for an understanding of the relationship between the archetype, algorithm and architecture. The philosophical investigation of archetypes, idea and form goes back to ancient Greece. "Ideas" or "Forms" in Plato's theory are the non- physical essences of all things, of which objects and matter in the physical world are merely imitations. The real world appears only as a copy of the archetypes. On the other hand, Jung says that archetypes are universal, archaic patterns and images that derive from the collective unconscious and are the psychical counterpart of instinct. Marshall McLuhan used the term archetype as a formal perspective rather than the content of an alleged "collective unconscious". In his book From Cliché to Archetype, the idea of archetype is presented as the ground where individual action is the figure. Along these lines, the archetype is understood as shared and universal, while the idea is subjective and manifests in symbols. Archetype stands as unrepresential in the understanding of philosophers. Aristotle, the first logician, confirms this by claiming that human thinking is the mechanical manipulation of symbols.

The link between the idea and the physical world is constituted by creation. In terms of design, Deleuze argues that creation has two components: it is always either based on copying or adding something new. In ancient times, the manner of copying was based on applicable rules. At the time, the medium for transmitting ideas was only verbal, without the opportunity to replicate something visually projected: the replica was realised 1:1 without any drawn instruction. Mario Carpo argues that there was a turning point in the Renaissance when not only the approach to space changed, but also once ideas became visually communicable. From this time, creation was based on models to imitate. This method was strengthened by the spread of identical copies created after the industrial revolution, spreading worldwide. A further turning point came with digital codes, which now make it possible to copy methods, with an always unique copy based on the same sequence of code - the method. (Carpo, 2011)

Examining the process of creation in history, it was primarily architects who were responsible for the whole design and implementation agency. After the Renaissance, these functions became segregated from each other, accordingly for a long time each field had its leader. This approach now might reunion again. Employing computational technologies, architectural design is a whole in the present and a whole in history. Whole in the present, because the actors of the process are not only aware of each other, but they are also conversant with the circumstances of real-time. Whole in history, because of the ability to track the usage of the building in harmony with the digital twin, a building can be reinterpreted from time to time.

AI offers more information for implementation in the architectural design in the interest of creating a comprehensive plan. Since architecture is always willing to create an appropriate and complete infusion of the resources, the almost perfect solution in the given circumstances, now AI can provide support for a closer approach to this goal.

Determined by the means of communication, archetype primarily was translated into each individual as a custom personal picture. This custom personal picture has been communicated through rules and models, which lead to several misunderstandings, since the same notion meant different picture to the receiver, compared to the sender. In order to uniform the message rules have been introduces to the thread of communication, such as sign system or typology. (Fig.2.).
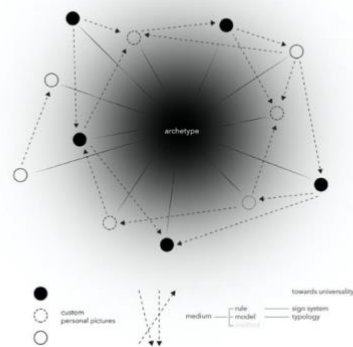
Figure 2. Relation between archetype and personal pictures transmitted by rules and models. Melinda Bognar, 2020.

Expressing the personal pictures through methods, the message is clear and explicit, allowing to precisely express each idea meaning the same for the sender and the receiver. (Fig.3.) This way the various pictures can be well defined composing an archetype including each unique understanding of the same general unconscious mental essence.
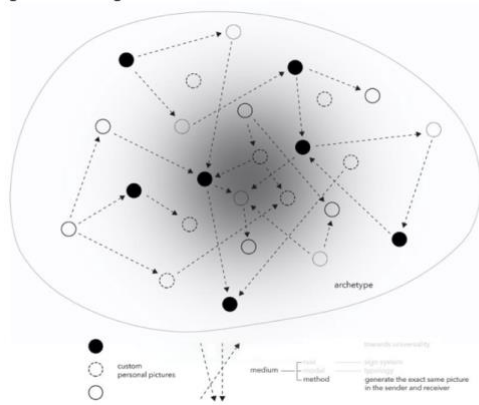
Figure 3. Relation between archetype and personal pictures transmitted by methods. Melinda Bognar, 2020.

For instance when we refer to a "house" everyone understands, but nobody identifies the notion of a "house" with one specific typology or form. It has become possible with the advent of computation and AI to change the meaning and behavior of the archetype. Thus instead of having one general notion which can embrace many specific understandings, we have the precise description of every single custom notion. The logic of the digital as Mario Carpo explains: instead of sorting now we are searching applies to the notion of archetypes as well. There is no need for a common category if we can precisely refer to every single custom phenomenon individually. This way the archetype becomes computable due to the precise description of algorithms.

5. Vision and Form

Computer Vision based on the operation of neural networks makes the projections more trustworthy. Visualization as the closest platform to transmit the idea based on statistical computations can provide a projection which is readable.

Statistical, numeric descriptions justify all the intuitive processes. The scientification of architecture started with its typification, and manipulation of types, such as manipulation of signs, as sawn in linguistics. Words, alphabets, symbols, codes are all means of information transmission in an ordered way accepted by many. In order to understand the information humans cluster and group. Since information is stored by 0s and 1s, the compression works in different ways.

Based on the ascertainment of Wittgenstein it is clear that communicating by pictures, or visual notions gives a clearer understanding of the speaker's idea. Compared to structuralism AI achieves universality in a different way. Understanding language as a sign system and Shape Grammars as rule based formalism, typology of Christopher Alexander was also a formal system to create clear, explicit communication. The goal of all such systems was to indicate the exactly same image in the sender and the receiver..

6. Computer Vision

Researchers began developing computer-enabled vision technologies as early as the 1950s, beginning with simple two-dimensional imaging for statistical pattern recognition. It was not until 1978, when researchers at the MIT AI Lab developed a bottom-up approach to extrapolating 3D models from 2D computer-created "sketches" that CV's practical applications became obvious. Image recognition technologies have splintered into different categories by general use case since then.

Computer vision refers to automation of the capturing and processing of images, with an emphasis on image analysis. In other words, CV's goal is not only to see, but also to process and provide useful results based on observation. Machine vision

refers to the use of computer vision in industrial environments, making it a subcategory of computer vision. (Appen, 2019)

Digital image processing is the use of a digital computer to process digital images through an algorithm. As a subcategory or field of digital signal processing, digital image processing has many advantages over analogue image processing.

Computer vision is an interdisciplinary scientific field that deals with how computers can gain high-level understanding from digital images or videos. From the perspective of engineering, it seeks to understand and automate tasks that the human visual system can do. Understanding in this context means the transformation of visual images (the input of the retina) into descriptions of the world that make sense to thought processes and can elicit appropriate action. This image understanding can be seen as the disentangling of symbolic information from image data using models constructed with the aid of geometry, physics, statistics, and learning theory.

7. Mimicking the learning data set

Machine learning approaches to pattern recognition. Pattern recognition systems are in many cases trained from labeled "training" data (supervised learning), but when no labeled data are available other algorithms can be used to discover previously unknown patterns (unsupervised learning). Machine learning is strongly related to pattern recognition and originates from artificial intelligence. KDD and data mining have a larger focus on unsupervised methods and stronger connection to business use. Pattern recognition focuses more on the signal and also takes acquisition and Signal Processing into consideration. It originated in engineering, and the term is popular in the context of computer vision: a leading computer vision conference is called Conference on Computer Vision and Pattern Recognition. In pattern recognition, there may be a higher interest to formalize, explain and visualize the pattern, while machine learning traditionally focuses on maximizing the recognition rates. Yet, all of these domains have evolved substantially from their roots in artificial intelligence, engineering and statistics, and they have become increasingly similar by integrating developments and ideas from each other.

The output generated by a learning dataset will always mimic the input. This way the formal and visual expressions of any AI architecture is inspired by the already existing forms and building elements. The standardised elements of the industrial era can serve as the source information of the customised computational design outcomes.

8. Conclusion, the scientifisation of the idea

This paper discussed the effects of AI to the creative process of architectural design with particular emphasis to the role of data based visualisation. Architecture traditionally is a twofold discipline, which always had the intuitive and rational sides in harmony. In the new episode the intuitive spectrum is also about to be expressed by calculations, computing the incomputable by creating statistically explicable notions. The computational tools are connecting the initial idea and the final project. As Marshall McLuhan famously said in 1964: the medium becomes the message. The phenomena of archetype has been transformed to a mathematically defined sequence of codes. The archetype can become a pattern generated from the learning data set of Machine Learning, which identification becomes possible in further image recognition processes operated by Neural Networks.

The Jungian archetype explained as a purely formal

element of the collective unconscious as the universal, archaic symbols and images manifested in physical or digital messages. The innate idea and the form coalesce by the archetype transforming the consecutive linear design to simultaneous creation.

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