Artículo de Investigación. Revista Killkana Técnica. Vol. 6, No. 1, pp. 21-30, enero-abril, 2022.
ISSN 2528-8024. ISSN Elect. 2588-0888. Universidad Católica de Cuenca

Architectural Neurology: Is It Possible To Design Architecture Through Emotions?

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DOI: https://doi.org/10.26871/killkanatecnica.v6i1.931

Abstract

This paper aims to propose implementing an innovative digital system for architectural design. This new method, based on the interpretation of human emotions for music composition, and the analysis of dreams, will be able to translate images based on architects' memories, emotions, and learning to design architectural spaces. If this system can build, how will it affect architectural design? Different investigations, studies, and analyses are needed to support and answer this thesis. The invention of a system for musical composition in London, based on the analysis of neural impulses and brain waves; the comparison between the process used for musical composition and architectural design through the explanation of renowned musicians and architects' methods; and the study of dreams through brain wave analysis would provide with results and possible benefits for a more straightforward method to design architectural areas. This implementation

will offer three benefits: accelerate the design process, automatically associate images and concepts, and have a pure and natural architectural design. Also, the system, capable of linking different images, concepts, emotions, and experiences, would provide various options of spaces produced by the architect. However, understanding that technology will keep advancing with time, human being labor is always needed to refine the method. An architect would be needed to define and choose between the different options of spaces that the system produced.

Keywords: *Brainwave, Emotions, Spaces, Technology*

Introduction

Technology can bring numerous benefits for improving the quality of life, improving processes, defining strategies for things conceived impossible, and mixing methods from different faculties to create innovative systems. Using the analysis and studies produced by professionals through technology discoveries would offer us possibilities to propose improvements in the different faculties. In this case, this document will study the possible implementation of an innovative digital system for architectural design. Applying this innovative method, based on the interpretation of human emotions for music composition and the analysis of dreams, would provide us with possible benefits to ease the process to design architectural areas.

Musical neurology: brainwave analysis

A revolutionary system of musical composition was created in London, which analyses neural impulses and brain waves for musical composition [1]. The brain-computer musical interface (BCMI) creates music in response to the brain's electrical impulses. The part of the brain that is analyzed is where the person can find brain waves produced through emotions. Emotions will depend on the activity of the different senses. Eduardo Miranda, a composer and computer music specialist at the University of Plymouth in the United Kingdom who participated in developing the system, created a sequence of patterns on a screen for the development of the study [1]. This programming consisted of a sequence of specific points based on colors, different patterns, and repetition to activate neuronal movement [2]. Thus, the outcome is a musical composition based on experience and emotion.

Figure 1: Subject's test [11].

This method of composing music is essentially digital and has been named "listening to the Symphony of Minds" [3]. Miranda uses a brain hat as the primary tool for his study, filled with electrodes and wires, picking brainwave visual cortex and ruling out any noise in the background to create music. The computer analyzes the

brainwave movement and sends them to another device that transforms this movement into musical notes [1]. Finally, this information is sent to a piano, which makes the sound created by the movement of the analyzed brain waves.

Miranda's study aimed to help disabled people through music. This way, music would be their therapeutic method. The development of brain-computer interfaces (BCI) allows users to control computer functions with the mind. These interfaces are generally based on the user's ability to learn certain mental states that brain-scanning technologies can detect. Miranda and his colleagues have used electroencephalography (EEG), one of the oldest of these systems: the electrodes in the skull for weak neural signals [2]. EEG signals can be processed quickly, enabling rapid response. Is it possible to use a similar method to create architectural designs through the study and analysis of emotions?

Musical composition and architectural design: musical composition

Musical composition and architectural design are related in several ways. Both are based on structure, dependent on the mathematics use, rhythm, context, culture, repetition, hierarchy, but primarily relying on emotions. On the one hand, we have the musical composition. There are different tools and methods which depend on the artist. For example, Beethoven used a technique based on repetition patterns to create the effect of predictable vs unpredictable. The unpredictable part became the song's climax and was its end [12]. The repetition and patterns part is called anticipation. Whereas, the part where the climax arrives, in architectural language the hierarchy, is called experience [4]. People who listen to Beethoven's songs choose this part as their favorite because they remember it due to its climax.

Stephanie Khalfa, a neuroscience researcher, analyzes the different emotions created by music, and vice versa, how emotions influence music composition [11]. She investigates several artists' musical composition processes according to their emotions. After analyzing several artists, she concludes that: Music consists of a finite set of parameters that can be arranged in different ways, following predefined rules [5]. These parameters are tempo, patterns of stress-relaxation, tone, intensity or volume. Music characterized by a fast tempo and a major key is associated with positive emotions, while music with a slow and minor key often causes negative responses [6].

Musical composition and architectural design: architectural design

On the other hand, there is architectural design. There are many methods, styles, tools and concepts for architectural design. For some architects, landscape, context, functionality, or structure would be the most important thing for the project. However, some architects focus on emotions to convey sensations and feelings [7]. One of them is the Mexican architect Luis Barragán, winner of the Pritzker Award, who focused the meaning of all his work on emotions [7]. As well as music composition, emotions would be involved in both the process and work outcome; this experience would be generated from users. Barragán manages to convey and be influenced by emotions through light and shadow effects, different materials, colors, and water, but above all, he focuses on photographic architecture [7]. Using these tools, he transmits his emotions in every space, strategically connecting them up to the main space, the garden (climax/ hierarchy).

Figure 2: Luis Barragan's Emotional Architecture [7].

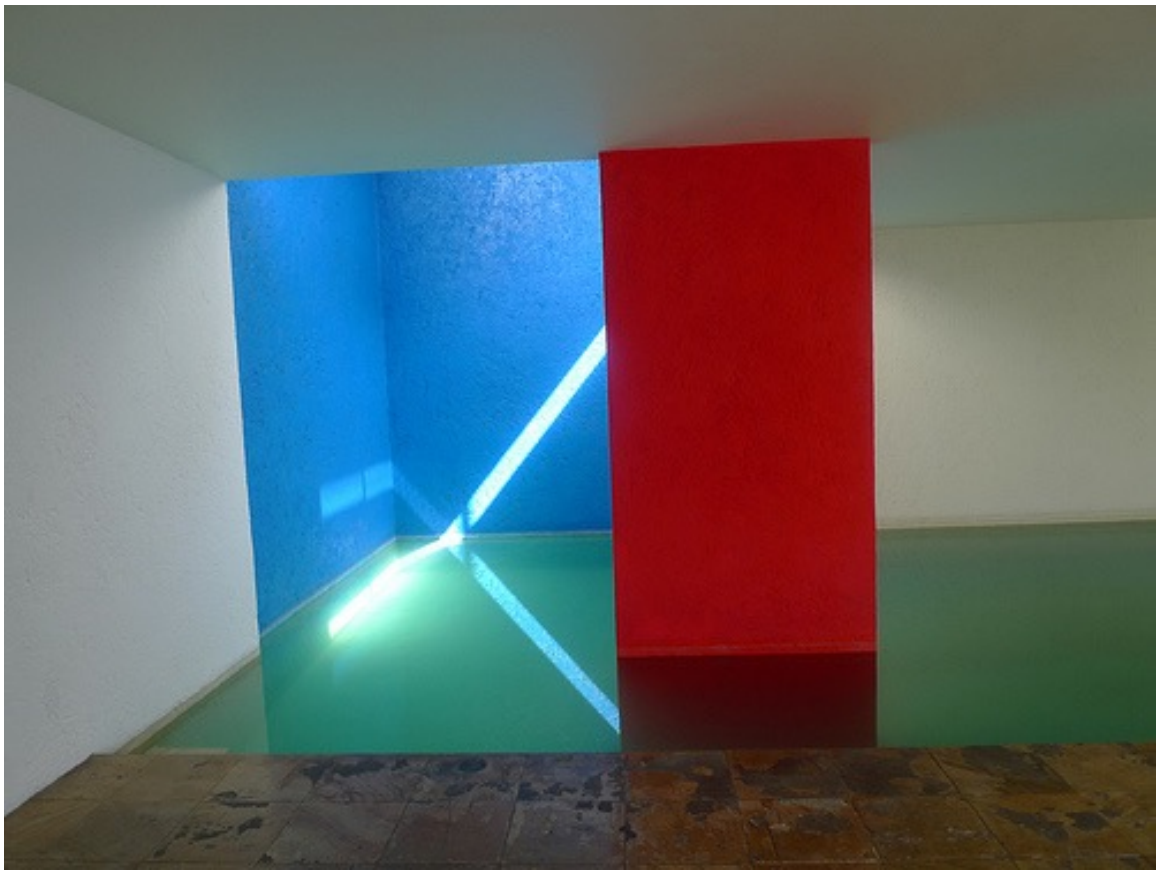

Figure 3: Luis Barragan's Emotional Architecture [7].

Architects usually begin their design with one sketch based on one or more images of their imagination. However, these sketches are only translated into lines and perhaps colors. Architects locate themselves in a specific scenario depending on the context and site of the project [8]. Thus, they focus on people's emotions, sensations, and movements inside and outside the establishment. Of course, for each person, the meaning will be something different, but the essence and meaning of each space will be the same. Architectural design is based on a concepts' compilation and preconceived images of different styles, shapes, materials and traditions, customized and manipulated by the architect to transmit the project's main idea [8].

Musical composition and architectural design: comparison between architectural design and musical composition

Currently, music composition and architectural design can be transmitted digitally. However, lots of information is lost during the process and is difficult to recover [12]. There are many emotions involved in composing music, and they vary through time quickly. That is why it has been so difficult for artists to compose in a completely natural way. This system has proved that a person can compose while his or her emotions are manifesting [5]. In architecture, architects make their sketches, but they miss many details from the original idea. That is because the images and emotions also vary with time. What would happen if a new system could translate the architects' images and emotions to design spaces?

Architects work with a photographic memory, so their designs are translations of the images they have in mind. The images stored inside their minds result from their past and daily experience [8]. Thus, the combination of these illustrations will be a personalized design in its details and global in its conformation. For example, Aldo Rossi's design method was collage [8]. He gathered some images, both past and current works, to organize all the information in his mind. Given the physical tools and preconceived experience, a space containing history, experience and emotions can be designed with a better approach [8].

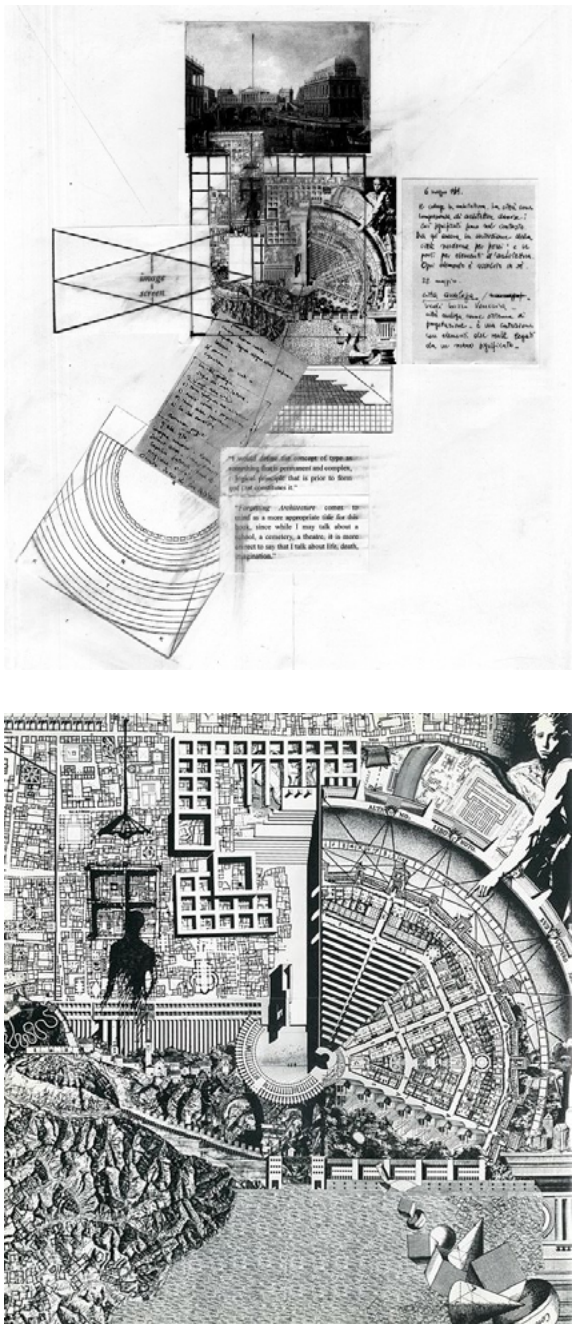

Figure 4: Aldo Rossi's design method (collage) [8].

Dream analysis: brain wave interpretation of dreams

In contrast, Jack Gallant, psychologist and professor of neuroscience at UC Berkeley, executed a study about dreams [9]. The analysis consisted of a brain wave analysis of volunteers while watching videos and images, followed by these projections' dreams' analysis. As a result, specific image associations appeared based on color, light, shadow and lines. Of course, these images consisted of not defined, blurry elements and were customized by each subject. It means that each person had certain detailed changes in the dream composition, such as the colors, the inclination and the size of the object or person in the video [9]. Thus, it can be confirmed that it is possible to convey people's emotions taking into account the experience and preconceived knowledge about various topics [9].

Figure 5: Jack Gallant's dreams study (Real video vs. subject's dream) [9]

Architectural neurology: system functionality

The proposed specialized software would be based on the concepts used in both Miranda's emotion interpretation and Gallant's dream analysis. The mixture of these two analysis methods gives us several results in an easier way to design architectural spaces. By interpretation, not only of brain waves but also of past, current and imaginative images, it could produce patterns of ideas translated into architectural spaces. These patterns will be recognized by connecting images projected in the head according to the emotions architects feel at the time. As mentioned above, architects usually locate themselves in an imaginary scenario before designing to recognize the emotions they wish to transmit with the project. Inside human memory, conscious and unconscious, specific elements call or call our attention in our lives the "climax" of important events. This system will collect and connect repetitive elements of the projected images. Thus, the system can provide various options of spaces produced by the architect. For example, the system can recognize that a Doric, gray or concrete column or a square window with a white frame is repeated in several images. These elements will be introduced to one of the final images of produced spaces. As a result, several

scenarios would be composed of different patterns: colors, materials, shapes, sizes, among others.

The machines that would make this possible would analyze the brain waves by separated processes, sharing the same space. First, as Miranda did, computers would analyze brain waves, tones, intensities, and variations. In this way, a specialized staff may make associations to analyze emotions. Then, there would be computers, which project images of architects' dreams, as in Gallant's studio. Finally, a person will guide architects to help them move within the project. After this process, the system would connect patterns using the information from both studies to produce several possible images for the different areas of a project.

Architectural neurology: architectural neurology benefits

Imagining that a system capable of linking different images, concepts, emotions and experiences to design an architectural space can be created, it could provide several benefits for architects. One benefit is accelerating the design process, so once architects have a defined image in their minds, it will automatically transform it into a digital form. It would save time on the production and design process. In addition, no information would be lost while the image is in their mind. Thus, the system will calculate Aldo Rossi's method, which puts together a collage of past and current images and experiences. The result would not be only one outcome but several. Just as Augustine Wing [10] states in his article, comparing technology with physical and social life, the person, in this case, would need to choose one result due to the most appropriate solution for their design.

The second benefit, related to the previous one, would be having an automatic association of images and concepts, which will depend on the memory and the changes within the architects' brain waves due to their emotions [9]. As previously mentioned, emotions are measured through brain waves, which can be identified especially through strong emotions, for instance, fear, happiness, loneliness, sadness, among others [11]. Similarly, as emotions can be recognized through the tone and speed of the music, in architecture, they can be associated with certain emotional spaces. For example, fear can be associated with a dark space. In contrast, happiness can be recognized by a bright and bold colors space. Sadness could identify using a neutral space with no color or contrast. There are several emotions a space can perceive, but not necessarily all people would identify themselves with that association.

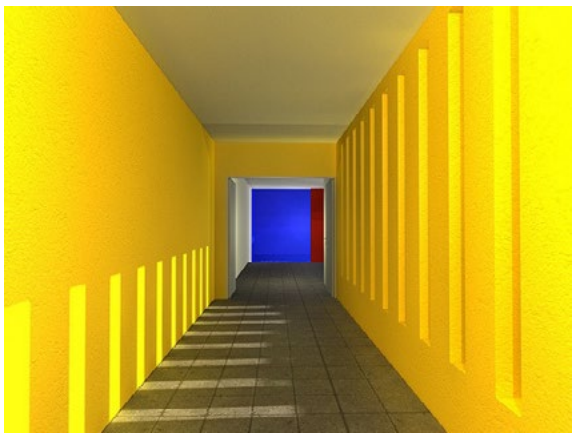

Figure 6: Emotions in spaces [7].

Figure 7: Emotions in spaces (happiness vs. loneliness), Emotional Architecture [7].

The third advantage is to produce a more sustainable, ecological, adaptive and resilient design and design process. Augustine Wing in "Automated Ecologies" [10] compares sustainability in architecture and urbanism with the micro-ecology of Amazon's automated warehouses. The document states that contemporary Architecture and Urban designs created by computers automatized machine intelligence have not engaged with social and physical environments. According to Wing's analysis, which gives an ecological view about the material and immaterial of machines' intelligence working in Amazon warehouses, this proposed new system will be considered eco-friendly. The term 'ecological` is based on the intersection between the digital and the physical world, as Wing states [10]. This system will give the same importance to the two physical and digital areas to merge them for an efficient result.

Finally, the fourth advantage is to have a pure and natural architectural design. The project will contain not only a physical and structured part but will also have a sensitive side. Our brain's image and experiences collection is organized hierarchically [5]. Just as in music, where we can recognize a song by its climax, our images and experiences are rated equally [9]. The most important memories in our mind would be those capable of awakening our emotions [7]. Therefore, the designed spaces will contain the most relevant information of our brain.

Conclusion

Concerning Wing's analysis in "Automated Ecologies" [10], the essential intersection is the relationship between space and time. The proposed new system will save time in the space design process and the required staff to achieve it. In addition, the design will be more ecological, natural and direct; this is cleaner and purer. However, human being intervention is always needed to refine the method. In Amazon warehouses today, the staff is needed to control and order the items in the factory. Similarly, for the new method, an architect is needed to define and order the different options of spaces that the system produced.

Technology will continue to advance over time. New technologies and operating systems will continue to try inventing machines to save time and personnel and improve processes. Regarding architecture, computer intelligence is increasing in the creation process. In this regard, Wing states: "In an age where space production is more intertwined to computation, negotiating complexity with a greater appreciation of the potential of intelligent machines will present unique opportunities not just for architectures "thinking, dreaming" but also its realization and habitation. What is certain is that intelligent machines are here to stay and will play a critical part in the evolution of the myriad ecologies of the post-digital condition" [10]. Further, human beings will always be part of technological advances.

Considering how technology advances, a system of this type could be built. This system could exist with some calculations, new technologies, applied theories, and studies. If this software can finally be made, the architectural designs will be promising. The only doubts we might have would be; can emotions from one space be transmitted to the people who inhabit it? Can anyone, regardless of profession, design architecture with this system? Can this system produce emotional patterns to design spaces by itself?

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Recibido: *10 de enero de 2022*

Aprobado: *31 de enero 2022*