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Original Research Article

Investigating the Mutual Influence between Architecture and Physical Identity, Based on Cyborg*

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Abstract

Problem statement: Body and architecture have always influenced each other. Today, human beings are exposed to vast social changes due to the growth of technology and globalization, facing an intelligent world that is becoming smarter every day and awes them with its complexities. What will the future of humans look like in this new world shaped by technology, of which artificial intelligence is an example? And what changes does architecture undergo under the influence of new physical features of the human body?

Research objective: It seems that the future body will be formed at the intersection of biology and digital technologies; a hybrid body – part human, part tools and technology – called the cyborg. The present study aims to answer the question 'What will the architecture of the present century look like?' by examining the physical characteristics of contemporary and future human beings, and it concludes by presenting some recommendations for the architecture of the future.

Research method: This study employed a library research methodology involving a review of the ways architecture can be influenced by the physiological characteristics of the body, the concept of communication, and the communication areas between the human body and its internal and external parts. The analysis started by categorizing these cases while discussing the examples of architecture inspired by the body.Then, the same process was followed for the new body, and the future implications of the study were scrutinized.

Conclusion: The development of the scope of impact of the building by digital tools, the use of deep neural networks to make the building intelligent, and the use of fluids to communicate messages at the surface and depth of the building are among the suggestions presented as biomimetic architecture.

Keywords: *Human body, Architecture, Biology, Cyborg, Biomimetic architecture.*

Introduction and Problem Statement

The human body – as one of humanity's fundamental models in cultural and artistic creations – is the core subject of this research. The way the body is placed in the universe also includes its relationship with the environment. The physical characteristics of human beings in different historical periods, including the human

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scientific and spiritual understanding of the universe, have been understood and interpreted in various ways. Therefore, and based on this ever-shifting perception, different ideals have been expected.

The still-unknown world of the human body is gradually expanding with the increase of human knowledge and awareness. Meanwhile, what this research focuses on is the way the human body relates to the environment, which after a brief review and classification of processes and patterns of communication between the body and the internal and external environment, develops towards architecture. This goal-setting is done by the identical positioning of the body and the building in the universe. It seems that, with the formation of a new world based on digital technology and the era of biological domination, human beings are faced with a novel world and new questions, for instance, what is the definition of the body in contemporary times? Or what effect will this definition have on the inhabited space of human beings in this day and age?

With the rapid advancement of information technology and its penetration into all aspects of human life, it is predicted that, within the next twenty years, the world will be on the threshold of the fourth wave of change known as the Virtual Era, which will undoubtedly transform architecture as well. (Mahdavinejad, 2019) Wireless technology has made it possible to integrate biological and technological bodies; a body that can be connected to the world. American author Kevin Kelly calls this period the beginning of neo-biological civilization; the age of things that are partly artificial and partly natural. Wearable computers – such as those seen in Behnaz Farahi's works – may be well on their way; computers that are directly connected to the biological components of the body, have great potential for creating human-to-environment and human-to-human interactions.

The present study is based on research conducted on the humans of the current century and their physical nature. Recognizing these features in comparison with what has happened in the past is a model for dealing with architecture and how it is located in the world, which is another part of the study. Biomimetic architecture introduces the physiological features of the body reflected in the architecture, ultimately focuses on the cyborg, and offers recommendations for the architecture of the future.

Methodology

Based on its purpose, the present study is considered basic research. The present study employed a library research method to collect the data. Therefore, the first section presents human physical identity throughout different eras and its impact on buildings. The second section is dedicated to introducing the physical characteristics of future humans. The present study necessitates in part inclusion of certain biological studies and related observations. The final section begins with reference to examples of bionic architecture and ends with recommendations regarding the architecture of the future.

Literature Review

The relationship between nature and architecture has existed for a long time and the physiological dimensions of the human body have already been reflected in the architecture and have been the source of imitations. This relationship extends from the imitation of nature to the imitation of its processes. Some believed that the building was a living organism. Others, such as Fuller and Frei Otto, were inspired by nature to define new structures. What has been going on in recent decades is the imitation of nature in behavior. Bionic science studies the structure and patterns of nature and uses them to solve human problems. In other words, bionics means the art of applying knowledge gained from living organisms to solve technical problems (Golabchi & Khorsand Nikoo, 2014).

One of the prominent Renaissance figures, Alberti considered the human body as a source of inspiration for architects, and in this view, he regarded a mutual relationship between architecture and the body;

architecture as a metaphor for the human body and the human body as a metaphor for architecture. Fellow Renaissance artist Filarete also insisted that the building comes from the shape of the body. He went so far as to liken the entrance of the building to the mouth and its windows to the eyes (Mallgrave. 2016). Schelling proposes three levels for architecture imitating nature. At the lowest level is the direct imitation of nature. At another level, architecture can equate with certain forms of nature, such as the human body, and at the highest level, the architectural form aims to achieve an objective end, which Schilling refers to as frozen music (ibid.). Other thinkers such as Burke, Kant, and Hebb believed in the involvement of neurocognitive patterns and the role of the brain in how architecture and beauty are perceived. The theories of Gestalt and Phenomenology have also each dealt with the influence of physiological factors on perception and architecture accordingly. Table 1 offers a review of the history of certain theories related to the human body, architecture, and how architecture is perceived by man and his body. The following section examines the body of the contemporary era

Table 1. Human body and architecture associations according to various thinkers. Source: Authors based on Mallgrave, 2016.

Time/ Thinker		Body-building relationship
Alberti	1404-1472	- Architecture as the recreation of the body
Filarete	1400-1469	- Building born out of the body form, its members and sizes
Da Vinci	1452-1519	- An effort to enhance the divine connection between the human form and the universe using geometry
Julien-David Leroy	1724-1803	- Offers a basic description of the sublime and the perception of beauty through the visual and neurological impact of architectural elements on the human brain - Architecture, a constructed form of neurological function
Edmund Burke	1729-1797	- Human emotions as a result of the neuro-physical perception process
Knight	1750-1824	- Aesthetic judgment is mediated by associative neural patterns in the brain
Kant	1724-1804	- The distinction between the phenomenal world and the sensible world
Schopenhauer	1788-1860	- Defends Kant's point of view that human interpretation of the world through the brain structure - The brain plays a central role in the sensory processing and cognitive interpretation of architectural form, linking perception to meaning.
Friedrich Schelling	1775-1854	- Architecture imitates nature on three levels: direct imitation as in the Gothic period, a level of finality as in the Renaissance period, and achieving objective finality (frozen music)
Carl Bötticher	1806-1889	- Bötticher's tangible and metaphorical understanding of architecture is similar to Alberti's understanding and physicality of architecture as an art
Wertheimer	1884-1943	- Founder of Gestalt psychology
Hayek	1899-1992	- Denying mind/body dualism
Hebb	1904-1985	- Percepyual events are grounded in neural connectivity
Neutra	1892-1970	- Architecture must build itself in a way that recognizes human neural identity - Multisensory Design: Architecture must go beyond visual qualities - Emphasis on the high sensitivity of the human's tactile sense and his sophistication in spatial perception
Merleau-Ponty	1908-1961	- Attempts to overrule the Cartesian mind-body duality - World-body system - Spatial and temporal perception depends on the presence of the body - All dimensions of the world are measured through the body as the starting point - Development of sensory organs
Juhani Pallasmaa	b. 1936	- Architecture as a multisensory experience

and what the future will have in store for mankind. What is this body and what are its characteristics? After learning about the characteristics of the new body, its impacts on architecture will be discussed and recommendations will be made in this regard.

Twenty-First Century Man. The Superhuman

In his book, Inhabitable Flesh of Architecture, Cruz (2002) offers a classification of the body as the classical, the grotesque, the bourgeois, and the modern. The classical body is based on geometric rules and is a reflection of nature and the universe as a whole. Also, due to the lack of knowledge about what goes on inside the body and the importance of physical beauty, the body is visual and the skin surface is the boundary separating the inside from the outside; this body ends on the skin surface and the world begins. The medieval body still has an unknown, mysterious interior; an unknown, three-dimensional body with protrusions, recessions, and openings from which disgusting substances come out (ibid.).

Between the Middle Ages and the twentieth century, human knowledge of the body evolved due to scientific advances and changes in philosophical theories. The Renaissance body is still visual and based on proportions. It was not until around the eighteenth century that this trend saw a fundamental change. At this point, the body could be scientifically studied and understood, and, due to its compliance with scientific laws, it became a machine made of flesh; a body aware of its own external skin. Thanks to greater scientific knowledge, the body's center of gravity was shifted from the viscera carrying the excretory material to the brain and the nervous system. During this period, in addition to separating the inside from the outside, the skin carries sensory and nervous messages and expresses internal characteristics. It also has a protective role and is in need of care (ibid.).

In the 21st century, we are witness to the redesigning of homo sapiens using new technologies and artificial intelligence. Bioengineering, cyborg engineering, and the engineering of non-organic beings are known as methods for this transition. In a sort of peaceful coexistence with computers, new humans upgrade themselves and gradually improve their mental and physical abilities.

Recent scientific findings on the algorithmic nature of the mental, physiological, and biological processes of living things have brought humans under the control of algorithms; algorithms that control and guide a living organism from somewhere outside of its body. Relying on genetic engineering, nanotechnology, and computers, this phenomenon – which turned the computer revolution into a biological revolution – has created the superhumans of the present century. This claim has been proven by the Robo-Rat experiments. In these experiments, the rats are made to do things that they normally avoid by implanting electrodes in their brains and stimulating the parts responsible for sensory functions. Interestingly enough, by stimulating the reward center in the rat's brains, they experience peak pleasure and relaxation. The same experiments can be applied to humans.

As with other stages of evolution, it is acceptable for some features of the human body to evolve; some features that are no longer needed will be weakened or eliminated over time, with other features being replaced or created according to the new conditions. The physical and mental limitations of the novel entity are overcome with the help of technology, therefore improving its performance. In his Phenomenology of Perception, Merleau-Ponty claims that tools can be a means of human thinking; they also can develop and reshape human senses. To describe this, he uses a blind person's cane as an example. By expanding a blind person's activity range, the white cane is within the range of his/her senses and is considered as part of their senses of touch and vision. Considering this fact, is it not appropriate to consider these tools as a part of a person's body? A tool that is placed within the dimension of human perception and has expanded

his/her scope of senses. The merging of tools with the body happens at the subconscious level, because, rather than their semiotic significance in cognition, tools influence the subconscious process of human thinking. Given this definition, a tool that can be subconsciously perceived as a body part can transform the very subject of the body, subconsciously reconstructing and redefining it (Hale, 2017).

In his article titled Extended Mind, Clark (2003) examines the boundary between the mind, body, and tools. In an example involving the use of pen and paper to solve a mathematical problem, he points out that in these conditions, pen and paper are part of the mind, making calculation impossible without them. Indeed, the brain function is not limited to muscle and arm control but also includes what takes place on paper. Likewise, Dennett (2017) describes control as the last criterion to identify the limits of a human being and considers "I" as a set of parts that can be directly controlled by a person. According to Dennett, the connection of the concept of "self" with the concept of any matrix of data controlled by a person, creates sufficient space for a biotechnologically compound "self".

Canny and Paolas, a computer science professor and a student at Berkeley University, are currently attempting to connect humans and robots to each other remotely and transfer information between them through an electronic interface, in other words, a complete replacement for the whole body. A sort of three-dimensional messenger for message transmission, along with the sense of presence over long distances. The objective of this research is to achieve a whole new type of human (Clark,2003). Hayles believes that the fact that the [conventional] body is replaced is not important, but that technology is reaching a unique physical awareness that is impossible without electronic prostheses; the boundary between living beings and machines is thus becoming blurred (ibid.).

The creatures that result from the combination of the human body and technology are known as cyborgs. The term cyborg is an abbreviation for cybernetic organism and refers to a creature made of both organic and cybernetic components. This new connection between the natural and the artificial has transcended the bodily boundary of living beings and has in fact become, according to Halacy in Cyborg: Evolution of the Superman, a bridge between mind and matter (Tegmark 2019). Moravec is also a firm believer in removing the human body and uploading its mind onto a completely artificial form. In Life 0.[3] Being Human in the Age of Artificial Intelligence, a book written by Tegmark (ibid.), this uploaded creature is introduced as the end of the cyborg spectrum, in which the only remaining human part is software and the other parts have all been replaced by machines. Works by artists such as Stelarc and scientific experiments by scientists such as Warwick confirm that the body surface is not limited to arbitrary physical boundaries. In the information age, in addition to the role of separating and defending the body against environmental elements, this boundary is also an expandable connector and medium and therefore takes on a variable, unpredictable, and transient nature. Neuroscientific findings also confirm the reciprocal relationship between the body and tools and the dissolution of the boundary between body, mind, and environment. According to Clark (2003), it is mental flexibility that enables humans to become cyborgs. The human brain works partially through biological organs and partially through external tools.

Cruz (2003) refers to a variety of concepts, including nano-cyborg, post-human, and extropanism, all created by technology, which all share a common use of technology and biology in shaping humans' new identity and physical abilities. In A Cyborg Manifesto, Haraway (2005) introduces it – the cyborg – as a newly created entity that transcends the traditional dual notions of natural/artificial, body/machine, man/woman, skin/flesh. And, therefore, she claims that we are entering a genderless age; a world in which there is no rigid boundary between natural and artificial, and the body is not defined by

a specific boundary. Now that we have learned about the contemporary body, let us discuss the influence of this body on buildings.

Discussion

• Communication-body; Biomimetic architecture[1]

The subject of human identity and self-knowledge has always been considered the foundation of human thoughts, and it can be said that the outer appearance and living environment are among the most evident aspects of human identity (Mahdavinejad, 2019). According to humans' definition of their own body, the body is defined and nurtured through its relationship to the environment, including its habitat. Therefore, it is not unreasonable to expect that the appearance and essence of the building are influenced by the characteristics of the body. In classical times, when the body is dominated by geometry, the building is also dealt with similarly. Proportions have become a central feature and reflect sacred matters and the connection with the universe (Fig. 1). In the Middle Ages, the building walls were thick, which made it difficult for the inside and outside to penetrate each other. Access between these two spaces is possible through holes that are embedded in the walls; the interior of this building, like the inside of a Grotesque body, is unknown and out of reach (Fig. 2). During the years leading up to modern times, relative scientific knowledge of the body led to the adoption of a scientific approach to dealing with it. The building wall in this period was the divider between the inside and the outside and represented what was inside the building.

The modern era is the age of the triumph of reason over emotion; this approach is also reflected in the arts and analyses done by the artists. The architecture of this period is the outcome of scientific findings and engineering knowledge, and, as with other realms of the human intellect, rationalism dominates the building (Fig. 3). Many examples demonstrate the imitation of the physiological structures of the body in architecture. Undoubtedly, this trend will continue to be pursued in the future, and, with the help of new technologies, cyborg body structures will be modeled by intelligent architects in the coming decades. Table 2 enlists some of the characteristics of the body across different historical periods together with concurrent distinct building characteristics of the same period. A Comparison of these data demonstrates the mutual influence of building and body on each other from different aspects. Now, we return to the main research question regarding how the cyborg body affects architecture (with a focus on the communication between the building and the environment): considering the characteristics of the cyborg body, what changes will architecture undergo? To answer this question, first of all, the examples of communication between the body and the environment are pointed out, and recommendations are made for architecture by pointing out the equivalents of these examples in the cyborg body in each case.

Perhaps the first and most obvious case for the communication systems of the human body with its internal and external environments are the senses, which are categorized as the main and somatic senses[2]. These senses and their physiological structures have been directly and indirectly modeled in architecture. Jean Nouvel's eye-inspired Arab World Institute (1987) is an example of modeling body structures. Also, the Kunsthaus Graz (2001) building by Peter Cook can be introduced as a successful example referencing the [human] skin. The use of various sensors in the building to receive data is reminiscent of the skin's ability to receive sensory and thermal data (Fig. 4). Equipped with covers connected to sensors, the eyes, ears, and hands of the cyborg will expand to a three-dimensional, digitally simulated, virtual, and imaginary world and the future superhuman will be able to control their limbs over long distances using robots and such technologies as augmented reality and virtual reality. As one of the main features of the body of a living creature, senses, which play an important role in its placement in the universe, adopt a different

Fig. 1. Parthenon, image by Kristoffer Trolle. Source: www.gpsmycity.com.

Fig. 2. Bunratty Castle, 1425, Ireland, image by Jon Sullivan. Source: pdphoto.org.

Fig. 3. Bauhaus, Walter Gropius, 1919-1933, Germany, image by Volkmar Rudolf. Source: wikimedia.or.

Table 2. Certain body characteristics in correspondance to building. Source: Authors.

		Characteristics/definitions	Architecture	
Classic Body		- Visual (beauty of appearance) - Proportionate, harmonic, based on geometric rules - Reflects nature and the universe - Skin is the boundary where the self ends and the world begins	- Based on proportions - The building envelope is the boundary between the inside and outside of the building	
Grotesque Body (Disproportionate)		- Visual, tactile, auditory - Disgusting excrement coming from an unknown, mysterious inside - Three-dimensional body with protrusions, recessions, and openings - Skin is the boundary where the self ends and the world begins	- Thick walls - Few openings - The building envelope is the boundary between the inside and outside of the building	
Bourgeois Body (from the Medieval until the Modern Era)		- Based on the sight - Can be understood and studied by science - The body's center of gravity is transported from the viscera carrying the excretory material to the brain and the nervous system - Skin is recognized as a sensitive part of the body (by medical science) - Understanding emotions through skin signs: skin reflects inside - Skin is the last layer of the body, a means to preserve energy and health	- Scientific approach towards building - The building's outer appearance represents its internal characteristics - The building envelope is the boundary between the inside and outside of building	
Modern Body		- Abstract - Standardized and measurable - Skin is the boundary where the self ends and the world begins - Mechanical tools expand the body and its boundaries	- Scientific approach towards building - Constructed using engineering knowledge - Dominance of rationalism	
Posthuman (Human Of The Future)	Cyborg	- Tactile - Unstable - Coexistence of body and technology, use of digital and mechanical means		
	Posthuman	- Based on touch	- Going beyond the skin boundary and beyond biological boundaries - Expanding physical boundaries using digital tools - Changing the concept of skin in terms of the range and layer - Penetration of the body into the surrounding space - The sense of dispersion of the human body - Breaking down the traditional sense of individuality	- Biomimetic architecture - Embodied architecture - Body-like architecture
	Extropanism	- Based on touch - Able to update and apply arbitrary changes. - Collapse of the traditional sense of individuality - The private experience of touch turns into a collective experience - Recreation of the body using novel tactile technology in virtual communications - Increase in penetrability and penetrative capacity of the body thanks to technology		

Fig. 4. Kunsthaus Graz (Graz Art Museum), Peter Cook and Colin Fournier. Source: www.archdaily.com.

characteristic in the cyborg body. The use of various sensors inside or outside the cyborg body can lead to the extension of the body over long distances; a body as wide as the range of senses. Moreover, with the help of advanced technologies, it will be possible to control and intensify the messages received from the environment inside and outside the body. The sense of touch is present in the building architecture through touching the surfaces, being stimulated by textures, and other similar strategies. In the cyborg body, touch covers vaster areas. The use of digital and mechanical equipment can create a sense of remote touch. The future building will embrace the user. It is possible that in the not-so-distant future, humans will be able to touch an environment far away from them by placing receptors and transmitters in the body and the environment. As science and the world of the Internet and metaverse develop, future humans are expected to witness the birth of super-cyborgs consisting of a building and the human body as a result of aligning the building with the body as an extended member.

The Biological skin has been used in the past as a model for architecture. One can refer to the models by James Fitch, Mike Davis, and Scott Murray as instances of architecture inspired by the skin structure (Rawya, 2015). The skin and the envelope as a whole – which includes the boundary of the internal organs of the body as well as the cell membrane – have first and foremost a protective role. In addition, due to its location, it is responsible for communication with the environment (inside and outside). One of the main features of this intermediate layer is its multi-layeredness in the sense that the skin consists of multiple layers, each of which has its own characteristics and is responsible for certain functions both separately and in combination with each other. Multilayeredness has been demonstrated before in architecture and in double-skin structures, such as facades and domes. Thanks to virtual reality, augmented reality, and metaverse technologies, the cyborg building is expected to contain a virtual universe layer (or layers) that will play its part in improving its performance.

Other noteworthy features of the skin and shell that can be modeled include the ability to respond and exchange with the environment. In a cyborg building, this feature will certainly encompass a wider range of senses, and, relying on more advanced technologies and inspired by the cyborg body, it will perform more accurately. Like the cyborg body, the building will be in contact with the environment and will respond to environmental stimuli accurately and purposefully within the shortest time possible.

The boundary of the cell is a system of interconnected, constantly moving membranes, wrapping itself

around all the organs and extending itself to the outer edges of the cell. It is, in fact, a conductive belt that is constantly being produced and destroyed. The membrane keeps its identity by regulating and maintaining the molecular composition of the cell (Guyton & Hall. 2018). Given the physiological characteristics of cyborgs and advanced computer science and electronic technologies, one can imagine that, in the future, the wall components of a building, like the cell walls, will have vital reactions. The ionic potential difference in the cell causes tension in the membrane and the transmission of messages. Simulation of this process in the skin of the building will lead to the creation of sensations on its surface and message transmission. Transmitting the characteristics of one building to another individual or building can be among the features of future buildings. This Transmission can be made possible through components or electrical and chemical codes based on certain structural similarities as well as similar physical and chemical communications. The transmission speed will vary depending on the transmission method. Transportable features may include color, brightness, roughness, softness, transparency, opacity, etc. As the third skin layer of the body, the building envelope can perform the same functions as the primary skin. It can, for instance, change the appearance and mood of a building using certain correction tools and internal features, such as changing colors and patterns. Applying these changes both deep inside and onto the surface of the envelope will be among the features of a cyborg building.

Another area where skin and shell can prove inspiring is the skin's soft structure. What is meant by softness and soft systems here are non-linear structures that constantly show different characteristics, forms, and patterns. These systems are able to adapt to environmental conditions and, in addition to being flexible, they can grow and change. As a matter of fact, changeability is one of the fundamental properties of these types of systems, and their stability lies in their ability to change. Such a feature is considered one of the main qualities of living beings. The change over time through the growth or gradual transformation of the shell components can be the quality of both the cyborg body and the cyborg building. Although soft systems have existed before in nature, the human body, as well as in architecture, this softness tends to be seen much more frequently in the artificial and attached structures in the cyborg body than in natural structures and will therefore be of a mechanical and digital nature.

Receptors and transmitters are undoubtedly essential in the physiology of organs. Somatic senses play a vital role in feeling pain, pressure, vibration, etc. as well as the way humans perceive the world around them. As materials become more malleable, and with the introduction of qualities such as multi-materiality and composite, and modeling after somatic senses, the emergence of more sensitive buildings will be foreseeable in the future.

Fluids fill different areas of the body in various ways and act as mediums of communication. About 60% of the adult human body consists of fluid, which exists in the body in three forms: extracellular, intracellular, and transcellular. Extracellular fluids include interstitial fluid and blood plasma that are often circulated throughout the body via structural vein networks. Mechanical and electrical installations that, like a network of blood vessels, move fluids across the surface and through the depth of the building and facilitate heat and energy conduction, as well as the air conditioning system, are all examples of network structures in architecture. In the buildings of the future, hormones and pheromones will flow in blood vessel-like structures. These fluids and currents can move and flow into different parts of the building and are a way to transmit messages at different speeds. These streams of data will stimulate the outermost physical layer of the building skin to respond to environmental factors appropriately and at the right time.

The living building of the future will be able to establish a mutual relationship with the environment.

This can be achieved by creating a deep neural network as a communications system and message transmitter throughout the surface and deep inside the building; a network that detects environmental conditions such as temperature, wind, etc., using receptors and organizes wall components based on the new data. Instantaneous and variable thicknesses are, thus, obtained in the envelope and other components of the building, optimizing its performance. Cognitive actions and reactions lead to the elimination of system errors in dealing with the environment and lead to self-organization. As a result, the building will become more experienced and possibly stronger over its lifetime.

Conclusion

As cultural history changes, so does our understanding of the human body and the meaning of the skin. Cyborgs seem to represent the 21st-century physiological identity as the century of biology and digital science. By recognizing the physical characteristics of the cyborg as the contemporary body, the groundwork is laid for answering the main research question about 21st-century architecture. Biomimetic Architecture deals with the ways architecture can be influenced by the physiological components of the body focusing on the subject of communication between the body and its internal and external parts, and while categorizing these instances, it points to examples where architecture has been modeled after the body, known as architectural manifestation. It finally follows the same trend in the new body and offers recommendations for post-architecture, the architecture of the future (Fig. 5).

Part of the communication structures of the human body is dedicated to the senses. Paying attention to the physiological details of the organs related to the senses, including the ears, eyes, and nose, will pave the way for conceptualizing and generalizing their functions to architecture. The dominant aspect of the senses is the receptors and transmitters that enable communication between the organs and the environment. This critical function has been and will continue to be implemented in intelligent buildings. Moreover, various communication mechanisms can be identified in these examinations which can be used as models for architecture. Networks, body fluids, skin, and cell membranes are other examples of the physiological structures of living beings, including humans, which play a major role in transferring materials and messages between the body and its internal and external environments. The neural network is also one of the other communication agents in the body, which takes an advanced form in the architecture of the cyborg body. This advanced neural network will have a vital application in the intelligent building of the future. The complete results of this study are presented in Table 3.

Declaration of No Conflict of Interest

The authors declare that they have no conflict of interest in conducting this research.

Endnotes

1. This paper engages with the concept of Biomimetic architecture. The theoretical frameworks of Embodied and Body-like architecture -examining the metaphorical and ontological interrelations between architectural form and the cyborgian body- will be addressed in forthcoming studies.

2. Somatic sences are neural mechanisms that receive sensory input from the entire body. They provide awareness of the effects of stimuli on the skin and internal organs, although their precision is not comparable to that of the special sences. The term‘special sences’ refers to vision, hearing, olfaction, gustation, and equilibrium (Best & Taylor, 1988).

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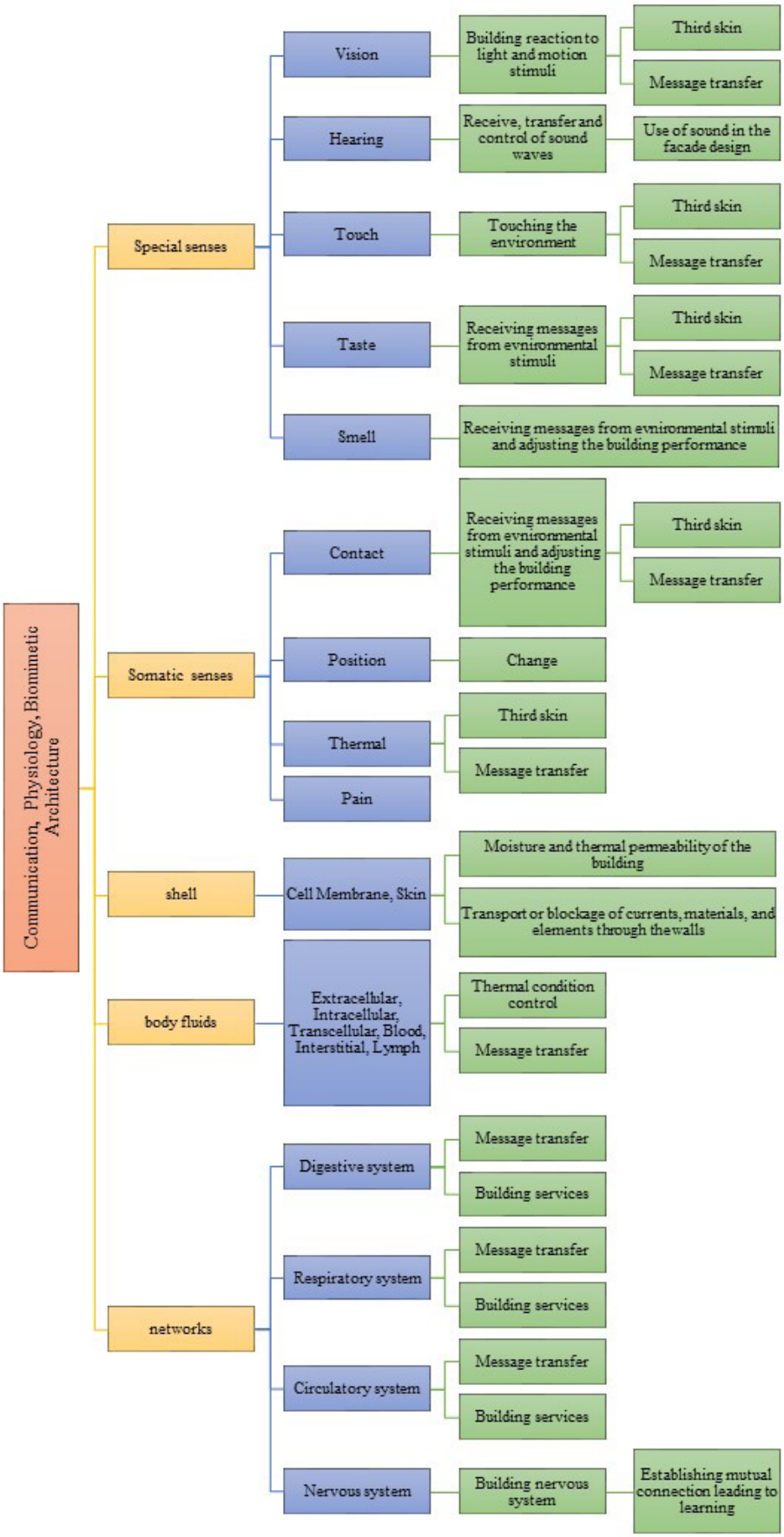

Fig. 5. Communication , physiology, Biomimetic Architecture. Source : Authors.

Table 3. Mutual influence between building and human body. Source: Authors.

Structure			Characteristics	Physiological manifestations	Architectural/ Manifestations (current)	Post architecture
Biomimetic Architecture	Special Senses	Vision	- Detects brightness, light, movement	- Eye	- Building reaction to light and motion stimuli	
		Hearing Tympanic reflex	- The mechanical connection between the three bones	- Transport of sound vibrations	- Transport of sonic and physical vibrations	- Transmission of sonic and physical vibrations to the building data center
			- Protecting the ear against extremely high vibrations -Covering low-frequency sounds - Lower sensitivity toward one's voice	-	- Controlling vibrations from environmental stimuli to establish comfort	
		Touch	- See Somatic Senses			
		Chemical senses Taste	- Chemical communication as the most suitable means for the emission of **carefully** selected answers			
			- Taste receptors	- Sensing tastes	-	- Possibility of receiving messages from environmental stimuli by the building mastermind to control the conditions - Controlling building response to the environment
			- Low bitterness threshold	- Protective function against poisons		
			- Taste adaptation	- Getting used to a taste over time		
		Chemical senses Smell	- Olfactory cilia - Olfactory adaptation	- Reaction with air molecules and stimulation of olfactory cells - Takes place in the central nervous system	-	- Possibility of receiving messages from environmental stimuli - Controlling building response
			- The emotional nature of smelling	- Recalling memories based on smells		- Building emotional response
	Somatic Senses	Mechanoreceptors Contact	- Touch - Pressure - Vibration	- Stimulation of contact receptors in the skin and tissue - Recurring sensory messages	-	- Possibility of receiving messages from environmental stimuli
		Position	- Static Movement acceleration	- Detection of tissue vibration and other rapid changes in the physical condition of tissues and deep tissue layers		
		-Thermo-receptors	-	- Detecting heat and coldness		
		- Pain sensation - Dull pain	- Sharp pain - Stimuli: mechanical, thermal, chemical	- Stimuli: mechanical, thermal		
	Physiology	Cell Membrane Hard and static	- Thin, elastic, and flexible structure Selective impermeability - Always active, Semi-permeable - Molecular regulation and maintenance of cell composition >>> Preservation of cell identity	- Cell membrane - Transport mechanism: Active transport, diffusion	- Permeability of the wall - Moisture and heat transfer through the wall	- Permeability of the building wall - Material transport through the wall - Always active
			- Walls with hard capsules	- Building wall	- Impermeable wall	
		Body fluids	- Exists in the body in the liquid and gel forms	- Material transport environment - Taking materials and oxygen to cells - Transport of internal cell materials to the bloodstream	-	- Message transfer - Building thermal conditions control using liquids embedded in the building materials
		Networks	- Nervous system - Respiratory system - Digestive system	- Vascular network, circulatory system	- Services	
				- Building nervous system - Intelligent building		-
				- Services		-
				- Services		-

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