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# PURITY OF ESSENCE IN ARCHITECTURE, A RADICAL REVOLUTION IN HUMAN-BUILDING INTERACTION

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## ABSTRACT

In architecture, buildings were looked at as machines that are purely programmed by humans but do not evolve and develop by themselves. Herein, the concept of living architecture, where buildings can have souls and grow with their inhabitants, has been introduced. This paper discusses how buildings can have empathy for their users, support their mental status, enhance their energy, help them increase the level of their task performance, and optimize living, working, and sleeping spaces based on assessing and understanding the preference and mood of the users rather than the preference and the experience of the designer. After reviewing major topics in architecture, technology, and psychology, this manuscript suggests pillars of the soul-full buildings where an architect can put the structure frame in which a building behavior happens and evolves within but does not decide about the precise behavior of the building. The difference between the purity of essence and the purity of form in architecture was clarified. Purity of essence in architecture means creating a building with what can be described as a functional soul (can engage with the user in intelligent conversation), while the purity of form is a soulless doll-like building (stunning looks but eventually obsolete).

Keywords: Interaction, Empathy, Adaptations, Intelligent, Architecture.

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# INTRODUCTION

Different types of building materials and designs have always been dynamic wheels that kept changing and improving over the history of humanity. This never-stopping wheel of architectural improvement created what we define today as modern and interactive buildings. However, buildings were always looked at as something that can be like smart machines which are purely programmed but lack interaction and soul. Herein, buildings are looked at as living entities that can grow and evolve with the users. The difference between a 20- and a 40-year-old person is not that the person sets out a set of goals at 20-year-old and achieves those goals by the age of 40. The difference is much deeper. It is the ability to grow as a person and adapt to unexpected events. That is called "human growth". A truly smart building is a building that can mimic human growth and can be referred to as "building growth".

What this study is trying to evolve in architecture is the purity of essence in buildings rather than purity of form. It is like trying to build a homunculus (created human) in alchemy with the focus of it having a whole soul, except that the focus herein is having a building with what can be described as a functional soul (can engage with the user in intelligent conversation) rather than a soulless doll-like building (stunning looks but eventually obsolete). Buildings that focus on appearances alone will be interesting for a relatively short duration of time but after that those buildings will become old and probably useless. The key to survival in any building is its ability to adapt to its environment (human and nature). Therefore, with the proper use of high-end technology that is available today, people can achieve better adaptive qualities for buildings than what was previously available (Hui et al., 2017: 76; Schmidt III & Austin, 2016). This concept is called the "purity of essence" which means finding raw resources (in our case behavioral patterns and instances), integrating the best that are available (study those resources and learn from them), and evolving those resources (grow and change them to better adapt to inhabitant's surroundings). This study discusses the already established three pillars of intelligent buildings and elaborates on how and in which ways buildings can grow with their inhabitants by proposing three novel pillars of the newly suggested concept: living architecture, or soul-full buildings.

### Purpose

Buildings has always been looked at as machines that are purely programmed by humans but do not evolve and develop by themselves. However, in this manuscript buildings were looked at as soul-full structures that can have empathy for their users, support their mental status, enhance their energy, help them increase the level of their task performance, and optimize living, working, and sleeping spaces based on assessing and understanding the preference and mood of the users rather than the preference and the experience of the designer. The purpose herein is to discuss how to create soul-full buildings that grow with the users rather than a soulless doll-like buildings. Furthermore, examples and suggestions about how living architecture can behave and interact with the users will be discussed.

### Framework

This study reviews the concept of intelligent architecture based on established architectural projects, and then suggests the concept of living architecture by introducing new pillars that are different than the known pillars of intelligent architecture leading to the concept of buildings that can grow, evolve, and develop with the users.

## THE THREE PILLARS OF INTELLIGENT ARCHITECTURE

In the modern understanding of intelligent buildings, an optimal intelligent building is supposed to self-produce energy to function and support its users, has a self-detection of faulty parts and the ability to propose solutions for technical problems, and be programmed to accommodate inhabitants' needs and comfort (Casini, 2016; Chang et al., 2018: 202; Degha et al., 2019: 21; Kotarela et al., 2020: 13; Pappachan et al., 2017; Salama & Maclean, 2017: 6) (Figure 1).

### Self-Production of Energy

Building technology is the biggest consumer of energy after power generation and transport (Cao et al., 2016: 128). Lighting, cooling, and heating form about 40% of the total energy consumption in office and residential buildings (Cao et al., 2016: 128). Embedding a renewable energy source in a building structure using solar or wind systems can make the building self-dependent in sustaining its own needs of power generation (Khan et al., 2019: 17; Sodiq et al., 2019: 227). Furthermore, water is another valuable natural resource, and an intelligent building can detect leaks in pipes and faulty meters thereby conserving water (Farah & Shahrour, 2017: 31).

### Self-Detection of Faulty Parts and Proposing Solutions for Technical Problems

Just like how a virus detecting program on a laptop can scan and inform the user about any detected problems, intelligent buildings may be programmed to self-detect faulty parts and detect the cause of any technical problems (Lazarova-Molnar et al., 2016). Depending on the level of building complexity, professional expertise might still be needed to decide about the optimal approach and repair of any faulty parts. Sensors, actuators, and cameras can be used for early faulty parts detections in the intelligent building to ensure human safety and comfort, and to initiate the repair system before a complete loss of the faulty part function (Lujak et al., 2017: 14).

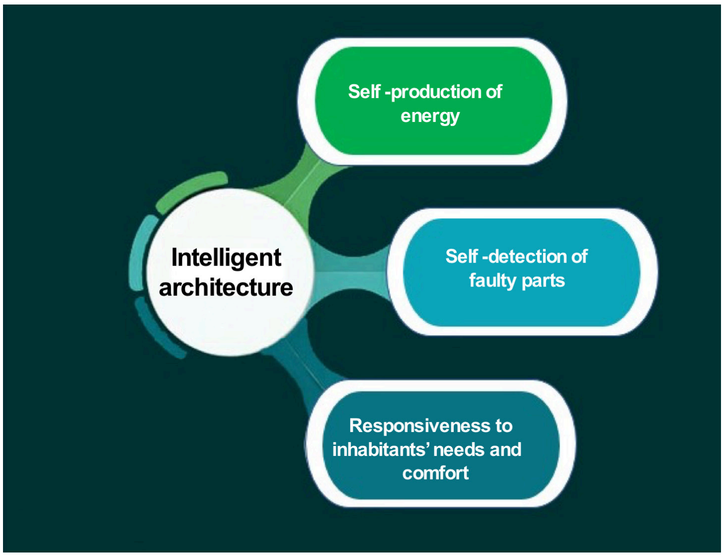


**Figure 1.** The three pillars of intelligent architecture

### Interaction and Responsiveness to Inhabitants' Needs and Comfort

Cameras and sensors are used widely in modern buildings to ensure the comfort of users (Hayat et al., 2019: 19). For example, doors and water taps can open automatically, machines that are programmed to get someone a drink or a hot meal ready and deliver it to the person's table through a mobile vessel, sensors for food items that are missing in a fridge, and automatic grocery orders can be used to restock the missing items (Ahmed & Rajesh, 2019: 9; Bhatt et al., 2020; Keluskar, 2019: 19), and parking spot availability detected through sensors that light pointing to the exact locations of empty parking spots are all features of smart buildings (Apanaviciene et al., 2020: 13).

## EXAMPLES OF INTELLIGENT ARCHITECTURE

### Legion House - Sydney, Australia

The Legion House is a fully zero carbon building and is considered one of the most sustainable designs in the world. The building coverts plant-sourced materials into a combustible gas which is then used to generate the building's own renewable electricity.

### Capital Tower - Singapore

The Capital Tower has 52 floors and was planned as the POSBank's headquarters. The building was opened in 2001 and parts of it would change their lights once every few seconds which makes it stand out visually at night (NAS, 2001). The Capital Tower has energy efficiency systems built-in, including an energy recovery wheel system in the air-conditioning unit, which is designed to allow cool air to be recovered to maintain a proper level of efficiency. More examples of intelligent buildings are shown in Table 1.

**Table 1.** Examples of intelligent buildings

| Name of the building | Location | Intelligent features |
|---|---|---|
| Leadenhall Building | London, UK | Energy meters to monitor the use of lights. |
| Oakland City Center | Oakland, USA | Advanced variable air volume system that collects information about the building humidity and temperature and responds accordingly to their changes in a cost-effective and sustainable manner. |
| Frasers Tower | Singapore | Smart Building CampusLink, which is a Microsoft Outlook and Microsoft Office integrated application that is used by the building's staff to easily determine room occupancy and book the best matching facilities in real-time. |
| The Edge | Amsterdam, Netherlands | Sensors conserve energy in the building by shutting down sections that are not in use. The building keeps a schedule for employees and gives them instructions of where to go to ensure they are at the right place at the right time. |
| Allianz Arena | Munich, Germany | Sensors and analytics system on Siemens' MindSphere platform to track the health of the grass on the field and to make recommendations accordingly. |
| Salesforce Tower | San Francisco, USA | The building uses a smart HVAC system and water recycling. Furthermore, it controls sunshades to cut heat from the sun. |
| Fulton East | Chicago, USA | AirPHX purification system capable of eliminating microbes and viruses on surfaces and in the air. |
| The Crystal | London, UK | Lighting control system for each lamp in the building to reduce electricity consumption. When the weather is good, the system opens windows to let outside air comes in. When the weather is cold, it automatically closes the window and initiates the interior ventilation system. |
| U.S. Green Building Council Headquarters | Washington, USA | Smart shade system to reduce lighting electricity costs. |
| Sacramento Ziggurat | California, USA | An uninterrupted power system (back-up power system), four separate fiber communication connections, monitoring facility through video security surveillance, units for controlled room climatic and temperature conditions, card key access, and a hydraulic elevator. |
| The Sinclair Hotel | Fort Worth, USA | Adjusts lighting preferences and water temperature based on personal preference. |

## THE CONCEPT OF LIVING ARCHITECTURE

Human movement within a site or building and how people interact with their surroundings, all of that can be materialized utilizing the current technology we have at our disposal. Buildings can create three-dimensional entities which include showing traces of users' movements, interactions, and presence but building themselves do not interact, they are static, petrified, or looping within a behavioral pattern like a ghost. However, in this manuscript the belief is that by using high-end materials, surfaces, and sensors architects can evolve from interactive architecture, where buildings react to their users within predefined patterns and functions, to living architecture, where buildings track users' activities, preferences, wants, and needs, and develop spaces based on the "understanding" of what can serve their users in an optimal way (Figure 2). This type of interactive architecture is starting to appear in evidence-based design or user-centric design (Bhatt et al., 2016; Kondyli & Bhatt, 2018: 44), but there are no buildings that can do this in real-time. This type of architecture engages with the user by speaking, interacting, changing, and adapting to better accommodate the needs of its users without compromising its own and showing that it has needs, identity, and presence. This goes beyond doors and water taps that open automatically to talking and responding. It is trying to metamorph from being a gadget to a presence of becoming a being. For example, empathy is a high level of human feelings. A living room can read its user's facial expression and behavior and "empathize" with the user's sadness by changing its wall colors to become brighter, and warm like yellow or orange, and project natural views on the walls and plays bird sounds to support and uplift the user's mood (Chang et al., 2020: 3; Mantler & Logan, 2015: 2; Ross & Mason, 2017: 83). Furthermore, the room might sense the user's low energy or feeling bored while sitting in a working spot. The room then reacts and starts to project moving walls to improve the user's performance (Adi & Roberts, 2011). Artificial intelligence is used to diagnose depression and assess the possibility of committing suicide by assessing changes in a person's behavior, speaking tone, and facial expression (Deshpande & Rao, 2017; Fulmer et al., 2018: 5; Lee et al., 2021). Those technologies can be implemented in buildings so those buildings can "assess" changes in the user's behavior and "realize" the need for mental support or initiate a warning to save someone's life.

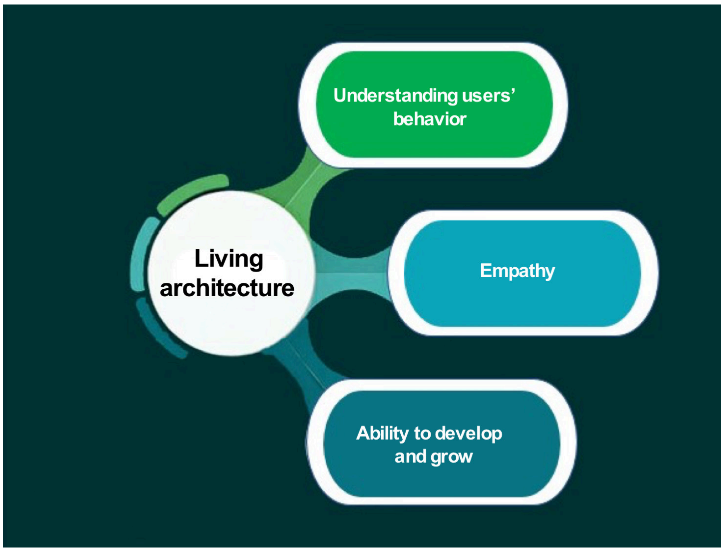


**Figure 2.** The three pillars of living architecture

An ideal living building is supposed to assess and understand users' behavior, show empathy, and be able to develop and grow to serve the users in the best possible way. More examples of living buildings include the room's ability to respond to more and more people entering it by making its space automatically wider and wider, but to a certain limit. Chairs can start to rise and appear automatically from the floor to accommodate the increased number of people accessing the room space. Rooms can monitor the level of lighting, heating, and cooling automatically based on a previous assessment and understanding of the inhabitants' preferences. Those preferences can be "understood" by the room by its ability to assess the facial expression, sounds, and behavior of the room's users. Further, a room can interact, talk, and autocorrect its actions in a way similar to the advanced technologies used on mobile phones such as Siri, or typing auto-corrector but with responses that can affect the physical environment features including wall colors, opening and closing of curtains, walls, or ceilings, and delivering room objects to where the person is standing in a way that supports the unique preference of the room's inhabitant after the room adapts and understands its user's behavior and habits gradually day by day.

## EXAMPLES OF LIVING ARCHITECTURE

There are no architectural projects that reflect the actual concept of living architecture as it is discussed herein. Therefore, the given examples about living architecture will be more artistic projects than architectural projects but they can be considered a foot-in-the-door to create living architecture.

### The Silk Pavilion - New York, USA

An architectural project by Oxman et al called the Silk Pavilion was designed in 2013 and used 26 silk-threaded polygonal panels laid down by a computer numerical control machine, and thousands of silkworms (Oxman et al., 2014). The purpose was to develop new calculation models for the design of fiber-based structures (Oxman et al., 2014). In this paper, the Oxman et al project was not looked at from a bio architectural view, but as an example of how an architect can put the guidelines of a building structure and behavior but leave the building to decide about different scenarios of user's behavior. This example applies to our concept of a living building when the building decides the best action based on analyzing its inhabitant.

**Yayoi Kusama Obliteration Room - Tokyo, Japan**

The obliteration room is an interactive art installation by Yayoi Kusama. It consists of a room that begins as white space and white furniture. The visitors to the room are invited to cover it with colorful dotted-shaped stickers, which gradually turn the room from a blank canvas into an explosion of colors. Kusama suffered from schizophrenia and obsessive-compulsive disorder (Beveridge et al., 2012: 201). She views her type of art as a channel in which she heals and allows the visitors to broaden their understanding of emotional intelligence. The example of obliteration room does not completely reflect our meaning of living architecture per se because the artist still specified how users can change the environment by giving them a specific tool (stickers), but it represents a foot-in-the-door example of human-building interaction especially when it comes to mental health and design interactions.

### TECHNOLOGY AND ETHICS

The "Internet of Things" (IoT) technology is widely used in smart buildings as a key enabler of intelligence in the building structure. Furthermore, IoT is claimed to give the building a kind of vitality, which makes it a great tool to support the spirit-full building design and implementation. However, according to a common view, it is discussed that the use of these technologies in buildings might create some privacy issues when the malicious software of these systems can be rendered to access private areas. Therefore, the protection of the users' privacy should always be taken into consideration when using technologies in buildings.

## CONCLUSION

This study resulted in clarifying the difference between the purity of essence and the purity of form in architecture. Purity of essence in architecture means creating a building with what can be described as a functional soul that can engage with the user in intelligent conversation rather than the purity of form which is stunning looks building but eventually obsolete. This study showed that to create living buildings that grow and evolve with their users, architects will not be required to design the end solution of a building (living room, bedroom, and an office) anymore, but to create a structured frame or guidelines of building behavior and leave the building free to make decisions about the precise behavior and develop itself based on assessing and understanding inhabitants' preferences and lifestyles. The hope is that such an approach will result in resilient buildings that have a strong connection to their inhabitants and environments where both buildings and users live together as one organism, creating deeper human-building bonds and meaningful interactions than what we currently know in interactive architecture. A living building that can respond and adapt to inhabitants' needs is not outside the reach of humans and can be achieved through collaborations between multidisciplinary scientists and experts including architects, artists, neuroscientists, psychologists, computer scientists, mechanical engineers, and electricians. Furthermore, technologies including immersive virtual reality to give the feeling of moving walls, 3D projections, wireless connectivity can all be beneficial to maximize the building performance.

Authors' Contributions

The authors contributed equally to the manuscript.

Competing Interests

The authors have no conflict of interest.

Ethics Committee Declaration

This study does not require an ethics committee declaration.

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