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A THEORETICAL APPROACH TO ENDORPHIN-STIMULATING ARCHITECTURE

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Abstract. As with the other creative and design industries, architecture is mainly aimed to solve users' needs. However, in the current practice, the design transformation process is less responsive to user feedback and primarily relies on the architect's perceptual skill that tends to be subjective. Innovative architectural problem-solving strategies can be derived from neuroscience knowledge, allowing a more scientifically proven user-centered design. The interdisciplinary collaboration in architecture design, neuroscience, and artificial intelligence may offer a new concept generation to design our built environment. The neuroarchitecture design approach, combined with artificial intelligence engineering, can create an environment that produces impulses that directly affect the human brain's response and induce happiness. Endorphin, called the happy hormone, can be stimulated to develop happy feelings essential for today's stressful life. This theoretical study aims to determine how architectural elements affect happiness through endorphin stimulation. An interdisciplinary literature study involving architecture and neuropsychology of both theoretical and methodological was adopted to explore this possibility. The result showed that the architectural environment could generate happiness, potentially indicating the endorphin presence. This study recommends using Virtual Reality apparatus to experiment and a blood test to check the endorphin level in the human body.

Keywords: Architectural design, design process(es), endorphin, neuroarchitecture, artificial intelligence, psychology of design, user-centered design.

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1. Introduction

Architects consider various objectives when creating designs, such as safety, health, comfort, and beauty. According to Vitruvius, firmitas (strength), utilitas (utility), and venustas (beauty) are the most common principles of architecture (Afra, 2012). However, in the wake of emerging trends, architects are inclined to add more attributes, such as energy conscious, eco-friendly, and humane, to the mix. Safety and health are presently the main attributes needed in creating designs; therefore, they cannot be ignored and bound by codes and regulations. For instance, a building must be strong enough to withstand an earthquake to meet safety standards. In addition, it needs to be appropriately ventilated to meet health standards.

Meanwhile, in contrast with beauty, comfort is often negotiable and depends on the users' tolerance for discomfort, although it is necessary for a good design (Stevens et al., 2020). Beauty is the most dominant aspect, mainly when an architectural object is seen for the first time. Although it is not as vital as safety, health, and comfort, it also plays an essential role which is understandable because visual contacts are the first initiative people consider when observing an object. The initial impression when someone sees a building is a key factor for judgments towards its value. For that reason, to impress the users, architects pay adequate attention to the beauty of their design. In addition, it is more of their concern to ascertain the safety and health measures of a building and not the users. Therefore, comfort is the second factor considered after beauty when using an architectural product.

Comfort is a highly vital factor because of its complex response from humans. It does not exclusively involve physical aspects. Instead, it is associated with psychology. For instance, supposing beauty is based on visual perceptions, physical comfort would be dependent on smell, touch, and hearing. Sensory inputs from the eyes (visual), ears (audio), and skin/tactile (thermal, touch) are comprehensively processed by the brain to determine whether the surrounding environment is comfortable. The physical aspects compensate for the other inadequate factors. For instance, cold surroundings can be made warmer with music (Kämpfe et al., 2011) and warm lighting (Tantanatewin & Inkarojrit, 2016). Meanwhile, the physical aspects that contribute to comfort also need to complement the person's temper to obtain a decisive judgment. An individual

with a good sense of humor tends to possess a higher tolerance level of discomfort than a distressed person.

Architects create environmental comfort to induce happiness. Hopefully, joy produces the much-needed peace that constitutes a high-quality life. Comfort that provokes joyfulness is suspected to yield positive effects, such as increased work productivity (Lipczynska et al., 2018), quality rest (Tsang et al., 2021), and well-being (Horr et al., 2016). In this study, architects envision the impact of their design on the user's happiness which is physically manifested by happy gestures, satisfaction, relaxation, etc. They generally do not care about the biological mechanism that induces those happy gestures.

In the medical field, happiness is triggered by a couple of hormones, namely endorphins (Rokade, 2011), oxytocin (Uvnäs-Moberg et al., 2015), dopamine (Klein et al., 2019), and serotonin (Jenkins et al., 2016). Endorphins are also referred to as happy hormones (Hasin et al., 2018). However, with the aid of various knowledge and information, architects are able to create a comfortable space that evokes happy responses from users. Happy gestures (mimics) are enough indicators to determine whether architectural design successfully induces comfort.

The dialogue between architects and neuroscientists results in a new paradigm in architectural design. The knowledge and tools "borrowed" from neuroscience allow measurable feedback from the users that informs the concept generation. Architects became more aware that their brain works in a unique way when they do the designing and also that their designs cause the human brain to react correspondingly. The data gathered can be studied to explain the causal relationship between stimulus and response that can become a new source of inspiration in the creative process. Compared to the quantified-self assessment method, the neuroscience equipment can provide a more objective result with a lesser rate of self-reporting bias. Thus, understanding or anticipating how the human brain reacts to impulses created by the architecture environment becomes a more effective approach in design.

The research also urges to combine more science (in this case, biology and psychology) into the design to bring more comfortable environments. Modern life is synonymous with stress. A study found a 14.9% increase of people with anxiety disorders worldwide from 2005 to 2015 (GBD 2015 Disease and Injury Incidence and Prevalence Collaborators, 2016). An environment can have a role in influencing a person's emotion and mood (Shearcroft, 2021), to provide solace at home after a long day or a less stressful public space. It can accommodate an answer for the increasing mental health problems. It is vital to focus on other aspects outside aesthetics that are strongly correlated with inhabitants' preferences. Although happiness is also subjective, it provides more dimensions to a design. It may lessen stress levels to a certain degree. Architecture can help increase comfort and happiness by designing the optimal configuration and applying appropriate technology for the inhabitants (M. Li et al., 2018). Designers need to consider more comfortable environments at home and explore aspects other than thermal, such as acoustics. Moreover, technology can bridge the gap between subjective and objective measures to bring more optimal results.

Endorphin, a hormone that influences happiness, affects a person's emotions and mood (Ghosh, 2018). In the long run, it impacts a person's psychological state. As mental health problems are increasing, our indoor and outdoor environments have a role in providing comfort and relieving stress. As city life becomes more hectic and crowded, a carefully designed room to induce endorphins may affect a person's emotions at the moment. This approach allows the design to be quantified to provide more calculated measures of comfort. Meanwhile, physical comfort may consequently impact a person's quality of life. With the technological advancements now, designers can work beyond their field to provide optimal results.

This research aims to uncover the possibilities architects can create in designing an appropriate environment that directly affects people's endorphin-inducing sensors or happy hormones. Hopefully, in the future, a more effective design that makes users feel joyous will be adopted.

2. Theoretical review

2.1. Neuroarchitecture

In the past, neuropsychology was only related to mental illness and used to describe the brain's structure with respect to the different types of mental disorders. Nowadays, neuropsychology is described as the connection between human behavior and the functions of a specific part of the brain. Therefore, it describes the role of the brain in respect to the different ways an individual thinks, feels, and behaves when mentally/physically sick and in a healthy condition. Built environments, in this case architecture, impact the human brain and behavior. The application of neuroscience in those built environment designs to obtain a certain impact on the human brain is called neuro-architecture. Alvar Aalto sees it as an extended Rationalism where architects broaden their design method through psychology and mental areas (Pallasmaa et al., 2013). The term cognitive architecture is somewhat similar but focuses on the impact of buildings and cities on people through psychology and cognitive sciences (Sussman & Hollander, 2021).

One of life's primary goals is to achieve happiness, which is described as a basic emotion experienced by people universally. Besides, words such as happiness, welfare, well-being, life satisfaction, and positive affect are often used interchangeably. Moreover, architecture is an essential instrument of human happiness with different key elements that affect people's experiences and emotions. Therefore, without these, it does not entirely satisfy one's happiness.

In 2018, 55% of the world's population lived in urban areas, and according to the United Nations, this figure is expected to increase to 68% by 2050. Irrespective of Asia is poor urbanization, it is the home of 54% of the world

population. In many parts of the globe, densely populated regions are problematic due to poor healthy environment, sanitation, green area, and public spaces, playgrounds, or parks, which eventually affect the mental health of the inhabitants. In the study entitled "A Place between Architecture and Happiness: Urban design for joy and well-being," Lee depicts the connection between urban design and the happiness felt by the people living in Copenhagen. This city was awarded a high score in the Urban Design for Happiness Index (Qun, 2018). The town depicts a harbor where people catch enough sunsets, which keep them happy. It embraces sustainable green living; in addition, people tend to swim in the clean waterfront in its harbor. Adults and children also participate by dipping the springboards in the blue river. The inhabitants participate in a series of activities daily. Therefore, they seem to be naturally happy as the inhabitants tend to utilize various spaces during their spare time, earn positive energy, and have fun. Happiness is a condition that people need to strive for because it does not emanate automatically. Moreover, community leaders and the government need to develop urban landscapes that contribute to this quality. Lee further reported that urban lives are related to the inhabitants' lifestyle, work, and leisure, from their personal life to the city environment where architectural design contributes to people's happiness.

2.2. "Live" architecture and artificial intelligence

A combination between neuro-architecture and artificial intelligence creates a "live" architecture that gives a dynamic (real-time) stimulation to human brain to produce a certain mood such as happiness (Azzazy et al., 2021). Artificial intelligence is commonly adopted in smart buildings to control mechanical and electrical equipment automatically. By embedding neuro-architecture design principles, artificial intelligence can be used to orchestrate the building environment system (audio (Mrówczyńska et al., 2019), lighting (Khorram et al., 2020), HVAC (Ciulla et al., 2019)) and create a brain-stimulating environment. In this case, artificial intelligence is not only to control lighting ON/OFF to save energy, for example, but also to provide a dynamic (real-time) visual environment with appropriate intensity, color, and pattern (Kandasamy et al., 2018; Wojnicki et al., 2017). Thus, neuro-architecture innovates the current application of artificial intelligence in architecture. Neuro-architecture and artificial intelligence challenge architects' creativity to make a new design trend that directly impacts the human brain.

Numerous research have looked at AI in architecture. Merabet et al. looked at the application of AI in predictive control of HVAC systems, detection and recognition of trends, optimization, and electricity consumption to maintain thermal comfort and energy savings in buildings. From 1993 to 2020, energy savings of between 21.81 and 44.36% and comfort improvements of between 21.67 and 85.77% were made possible by the use of AI approaches and individualized comfort models (Halhoul Merabet et al., 2021).

Debrah, Chan, and Darko examined studies on in for green building in the meantime. They put forth several research directions for the future of artificial intelligence in green construction, including digital twins and AI of things, blockchain, robotics and 4D printing, and the moral, ethical, and legal obligations of AI in green building (Debrah et al., 2022).

Yan, Hao, and Meng's study examined the evolution of AI trends in the fields of energy efficiency and zero-energy buildings across time. AI and energy efficiency have been linked to several technologies, including IoT (Internet of Things) for sensor applications for thermal comfort, platforms and algorithms for controlling multiple building energies, and forecasting techniques for subsystem performance, building load, and structural safety. They predicted that tenant presence and behavior could likewise be analyzed via IoT (Yan et al., 2021).

3. Methods

A literature study method was adopted to explore the possibility of architecture in terms of inducing endorphins to trigger happy feelings. Subsequently, three areas were investigated, namely, comfort, neuropsychology, and architecture. The connection between endorphin and happiness was viewed from the psychology and architecture perspective. Therefore, no blood test was carried out to measure the endorphin level, commonly executed in the medical field. As a result, the discussion was more qualitative rather than quantitative. In our future study, a blood test will be applied to understand the level of endorphins.

The research method will use VR headsets to show pictures (scenarios) to the respondents. The scenarios are outdoor and indoor images (photographed and/or rendered) with different settings representing comfortable or uncomfortable configurations. The variables on each image differs in the quantity of greenery, building density, and material types. For instance, a photograph of existing condition is compared to a rendered image of the condition with different greenery, material, and building density. Simultaneously, a blood test to measure endorphin levels will be conducted while the respondents view each scenario. The responders will be measured within the first five minutes of viewing each scenario with the VR headset. Respondents were measured in normal conditions (i.e., not unwell, not having just finished a strenuous activity). The respondents will also asked open-ended about their subjective experience after the VR experience.

Meanwhile, secondary data collection can implement Scopus, Web of Science, Science Direct, and IEEE Xplore, as they offer studies on both architecture, psychology, and technology and their connection to one another. There are several keywords to search on the database: comfort, happiness, architecture, interior, greenery. Afterwards, cross-tabulation can be used to see and compare the

similarities and differences in each study, to see whether there's a pattern. Then, we discuss the results of both primary and secondary data analysis to see whether other studies on happiness and architecture also show similarities. Solutions for indoor spaces will be more focused because time is spent more in indoor settings (Saini et al., 2020).

Figure 1 shows a virtual urban oasis constructed using Unreal Engine software from a study by Pansela et al. The study inspired the analysis of endorphin-induced architecture to discover the effect of the environment on the human stress level. Three respondents were involved in the experiments, and their heart rates were recorded. They wore a VR tool, Oculus Rift S. The stress level was discerned with an electrocardiogram (ECG) tool that measured electrical activity in the heart, namely Polar H10. According to the test analysis results, heart rate variability (HRV) increased by 8% (from 50 to 58%) after an average heart rate (HR) decrease of 11% (from an average of 82 bpm to 73 bpm). This suggests that environmental rehabilitation has an 8% impact on an individual's stress level. The impact of urban oases on heart rate serves as evidence of how architecture affects human emotion (Pansela et al., 2021).

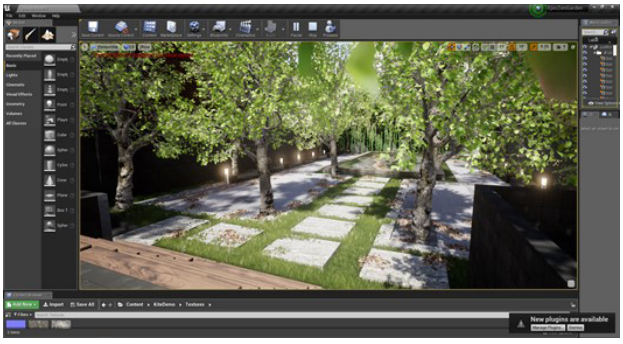

Figure 1. Urban oasis is placed on land subsidence to reduce noise from the city environment. This reduces noise by relatively 40dB. Trees with bushy leaves were chosen to provide dynamic shadowing effects and natural sounds

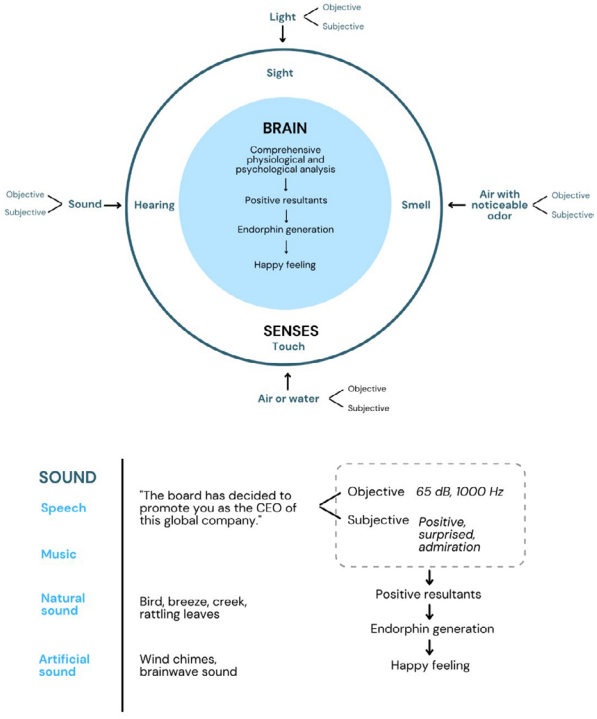

Figure 2. From impulses to happy feelings

The test analysis results showed an average heart rate (HR) decrease of 11% (from an average of 82 bpm to 73 bpm) followed by an increase of 8% (from 50 to 58%) in heart rate variability (HRV). This indicates that the effectiveness of environmental recovery on a person's stress level is 8%. Therefore, the effect of urban oasis on heart rate aided in proving the influence of architecture on human emotion. Besides, a literature study also initiated that experiment. Study by Banaei et al., involved 17 healthy right-handed participants using mobile brain/body imaging (MoBI) to record the EEG of the participants. They used virtual reality technology to simulate natural walking in different interior forms and monitored the impact of environment to human brain dynamics. This experiment concluded that virtual environment appeared real to the participants, and different rooms perspectives led to different areas of the brain that were stimulated (Banaei et al., 2017).

Figure 2 shows the logic behind the research hypothesis. Every impulse has objective and subjective sides. The objective is tangible and measurable using corresponding instruments; moreover, its results are expressed in units. Meanwhile, the subjective side is intangible and less measurable and is usually expressed in abstract words. Figure 2 shows how the human brain processes the environment that surrounds the person. It starts with the sensory inputs with each body part responsible for sense being transmitted to the brain. All inputs are objective (measurable) and subjective (more related to the opinion of each person regarding the experience). Then, the brain processes the inputs according to the person's intrinsic values to determine whether the experience is positive or negative. If positive, the brain will induce endorphins to be released so that the person can experience happy feelings. The process happens quickly, as it occurs subconsciously.

4. Results and discussion

Based on this research, architecture addresses comfort because it is measurable. Meanwhile, happiness is only perceived as an addition to comfort because it is remarkably more abstract and subjective. Conversely, comfort tends to influence happiness and vice versa. Every impulse sends two messages, namely objective (measurable) and subjective (less measurable). Noise conveys an objective message that is measurable and subjective because people's preferences tend to differ. In the past two decades, neuropsychology has come to play in architecture. It helps quantify the previously less measurable parameters such as happiness, satisfaction, boredom, etc., to more accurate structures in the brain related to the variable(s) under discussion.

Mind and Pretty reported that exercising while viewing photographs or pictures of nature reduced blood pressure to a greater degree compared to engaging in such activities in the absence of photos or the presence of less green rural or urban images (The British Library, n.d.). In addition, when compared with achromatic and red filter videos, it was discovered that exposure to green and natural footage during physical exercises had been proven to reduce Rating of Perceived Exertion (RPE) and maintain positive mood effects (Akers et al., 2012). It simply means the importance of the scenery viewed by people and not necessarily the realness of the scene. Table 1 shows the elements considered by an architectural landscape that aid people in developing a positive mood.

Table 1 shows how natural environments can affect moods. It is an inexpensive solution for people to induce the production of endorphins, whereas indoor environments can be enhanced simultaneously with AI and smart devices. Natural environments have many properties that are difficult to control; for instance, relative humidity, air temperatures, sky brightness, and wind velocity.

Generally, health pathways relating to the natural environments are sometimes thought of as 4-folds. They include physiological (such as clean air), physical (offering opportunities for physical activities), social (by increasing the likelihood of social contact), and psychological processes (namely relaxation and restoration). Thus, implementing natural elements in urban contexts offers numerous benefits, including physiological, social, physical, and psychological (Patuano, 2020).

The endorphins-inducing principles are applied in architecture through the concept of the smart home, which uses comprehensive wiring, network communication, security, automatic control, as well as audio and video technologies to build efficient residential facilities. Furthermore, a management system is used to schedule affairs to improve home life's safety, convenience, comfort, environmental friendliness, and artistry (Alam et al., 2012). Architecture for emotion detection and regulation is possible using technology (Fernández-Caballero et al., 2016). Intelligent design is implemented based on the "five senses" namely visual, voice, tactile, cognitive, and emotional interaction (Z. Li et al., 2020). The impacts of visual stimulation on the users are measured in real-time. The current workflow involves the use of video input which is then analyzed through an Artificial Neural Network to ascertain read user's micro-expressions, thereby resulting in either positive, neutral, or even negative experiences (Rocabado et al., 2020). Therefore, integrating smart technologies into spatial settings potentially supports the creation of responsive endorphins-stimulating architecture.

Various methods had been used in the research on comfort and architecture, as explained in the earlier section. In our future study, besides using a blood test, we will also use Virtual Reality technology to induce the emotion that indicates comfort.

Architecture seems to follow along a path in providing a comfortable and happy environment. This is easily understandable through ordinary senses and knowledge. An environment with cheerful colors and lively music is

Table 1. The four principles describing why people enjoy green exercise activities (source: Mind in (Freeman, 2017), modified)

Principles	Subcategories	Descriptors
1. Natural and social connections	a. Social	Being with friends and family, companionship and social interaction, creating collective identity, making new friends, conviviality
	b. Animals and wildlife	Direct bonding with pets (e.g., dogs and horses) and wild animals (e.g., bird watching) (Grilli & Sacchelli, 2020; Yerbury & Lukey, 2021)
	c. Memories and knowledge	Visiting special places where memories and stories are evoked and recalled (childhood associations), story-telling, personal identity, links to myths, stimulation of imagination, ecological literacy
	d. Spiritual	Large scale and longevity of nature in contrast to humans, transformative capacity of green nature, oneness with nature (Yfantidou & Anthopoulos, 2017)
2. Sensory stimulation	a. Colors and sounds	Diverse colors of nature and landscape views, beautiful scenery, bird-song and sounds of other animals, light (especially sunrise/sunset), visual and aesthetic appreciation
	b. Fresh air	Smell, being outdoors, exposed to weather, changing seasons, in contrast to indoor and city life, escape from urban pollution (Burrows et al., 2018)
	c. Excitement	Adrenaline rush, exhilaration, fun, physical activity or risky experience (e.g., rock-climbing), sense of adventure
3. Activity	a. Manual tasks	Learning a skill and completing a manual task (e.g., conservation activity), challenging, fulfilling, and rewarding, sense of achievement, worth, and value
	b. Physical activity	Enjoying the activity itself and the physical and mental health benefits associated with it makes people feel good, more energetic, and less lethargic
4. Escape	a. Escape from modern life	Getting away from modern life, relaxing alone or with family, a time to think and clear the head, peace, and quiet, tranquillity and freedom, privacy, escape from pressure, stress, and the 'rat-race,' recharging batteries

Figure 3. An example of relaxation software that combines sound, music, brain wave, and visual presentation Natura Sound Therapy 3.0 by Blissive (source: Blissive, 2022)

an example of a happiness-inducing ambient. On the contrary, methods that aid to directly access happiness through the human senses have long been made available. A relaxation technique using brain wave sound is an example of how a non-musical sound induces a relaxing effect (Figure 3). Besides, this method is known as sound therapy. Furthermore, chroma, aroma, and light therapies are examples of directly accessing the brain to ascertain the feeling of comfort, relaxation, and happiness. By this mechanism, endorphins generate happiness, and it mainly works in the human subconscious.

Sound can have a relaxing effect. For example, Blissive is a white noise application used for relaxation (Figure 3). This application can also be used to reduce noise. The principle of this application can be included in a sound generator in a room to stimulate endorphin production in the body.

Blending colors, sound, and aroma, which complements architectural therapies, creates a happiness-inducing environment preceded by endorphin generation in the human body. Table 2 shows examples of impulses and responses to enhance the indoor condition. It shows how sensory experiences can be perceived in each individual, displaying the properties (measurable and subjective) and the solution to improve the environment relating to the senses by giving examples of healing.

Light therapy, sometimes known as phototherapy, is one type of treatment that involves exposure to artificial light. A light therapy box's typical output is between 2,500 and 10,000 lux. The intensity of the light box and how well you respond to the treatment will determine how long the session lasts (Sandkühler et al., 2022).

Meanwhile, aspects of music are used in sound therapy to enhance mental and physical health and well-being. The patient participates in the procedure under the supervision of a qualified professional. There are several possible activities during sound therapy sessions: playing an instrument, meditating, dancing to the beat of the music, singing along to it, and listening to music (Salamon et al., 2003).

On the other hand, aromatherapy is the application of essential oils for medicinal purposes. In essence, essential oils are plant extracts. Since aromatherapy has been used to treat anxiety, sadness, and insomnia, it can also be utilized generally for relaxation (Hassanzadeh et al., 2018).

Meanwhile, aquatic therapy refers to water-based treatments or exercises of therapeutic intent, in particular for relaxation, fitness, and physical rehabilitation. Aquatic therapy is also used for recovery after physical injuries. Treatments and exercises are performed while floating, partially submerged, or fully submerged in water (National Health Service, 2022).

Figure 4 shows how the algorithm for the AI system works in an individual setting. Firstly, the sensors detect how the room's user is feeling by detecting microexpressions on the face. There are sensors that detect noise, air temperature, and scents. Meanwhile, there is also a detector to recognize facial microexpressions (Hashmi et al., 2021), determining if the occupant is happy or unhappy. The system will not respond if the room's user is happy,

Table 2. From senses to mood

Senses	Impulses	Examples	Objective properties (measurable)	Subjective properties (less measurable/abstract)	Examples in healing
Sight (vision)	Light	Scenery	Illumination (lux), lamination (cd), color (R, G, B), hue, value, pattern, contrast, glare index	Positive: relaxing, calming, soothing, tranquilizing. Negative: scary, gloomy, depressing	Light therapy
Hearing (auditory)	Sound	Spoken word	Intensity (dB), reverberation time (second), timbre (spectrum), frequency (Hz)	Positive: comforting, admiration. Negative: harsh, provocative	Sound therapy, brain wave therapy
Smell (olfactory)	Air with smelly chemical	Perfume	Chemical composition	Positive: relaxing, soothing, fresh. Negative: stink	Aromatherapy
Touch (tactile)	Air, water	Breeze	Velocity (m/s), temperature (°C), relative humidity (%)	Positive: warm, cool, fresh. Negative: hot, cold, damp	Aquatic therapy
Taste (gustatory)	N/A	N/A	N/A	N/A	N/A

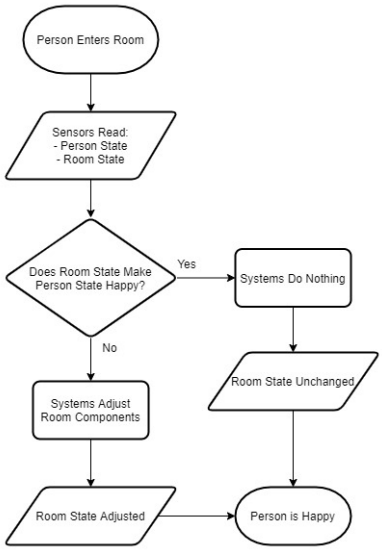

Figure 4. Algorithm for the AI system to induce endorphins that generate happiness

as comfort is subjective. The responses will include making the air temperature, scents (fragrance), and soundscape more comfortable by following existing standards.

The system is also applicable in corporate settings, but the system will generate the most comfortable environment possible by adjusting the air temperature to the thermal comfort range, adding pleasant scents, and making the soundscape in a comfortable range.

This will be very influential in an environment where the air temperature is not within the thermal comfort range for most of the year. So, people who enter the room can feel the room is more comfortable, especially when the outside air temperature is less comfortable. Feelings of pleasure through endorphin production can be achieved if the room user feels comfortable. Floor temperatures should not exceed 19–29 °C (66–84 °F) in areas where people will be wearing light-colored shoes, according to ASHRAE 55 (American Society of Heating, Refrigerating and Air-Conditioning Engineers, 2013). In contrast, office buildings have neutral sound pressure levels between 30 and 40 dB

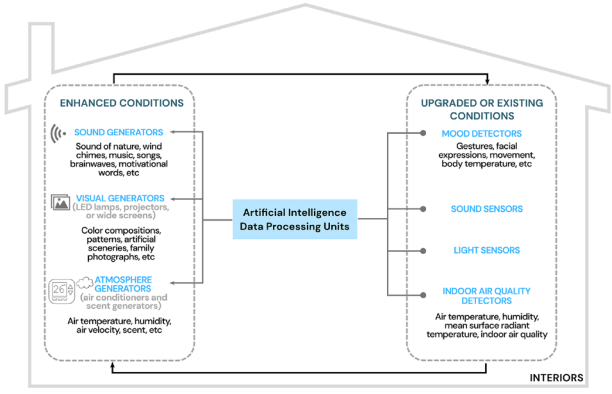

Figure 5. Design schematic of a room with an endorphins-inducing tool

according to ISO 13779 (International Organization for Standardization, 2018).

Figure 5 depicts a schematic design of an endorphin-stimulating tool that detects and processes the acquired data with artificial intelligent software and generates impulses to enhance and create a happy condition. It explains how the endorphins-inducing tool works in a room. There are sensors that each detects air temperatures, humidity, air velocity, scent, colors, and noise. Then, the system processes information from the sensors and determine what actions to take. If the environmental variable is in the comfort range, the system will not signal the generator related to the variable to take action. If it's beyond or below the comfort range, the system will induce the generators to adjust the environment. For instance, if an unpleasant smell is detected, the system will enforce the generator to put on a fragrant in a room while also detecting the user's mood. Then, the room will be more comfortable; thus, inducing happiness.

5. Conclusions

According to several references, the built environment and architectural elements affect humans physically and psychologically through impulses, which have objective and subjective sides. The human brain performs a comprehensive and complicated mechanism, which results in a feeling of comfort or discomfort in the environment. The exact mechanism also leads to a mental response of either happiness or unhappiness.

The effort to make architecture happy, satisfying, or comfortable is measurable by calculating endorphin production. It provides clearer guidelines or goals to achieve in architecture. In the end, technology is for our use, so it has to be applicable. The solution offers a breakthrough in technology to induce comfort and happiness. Comfort is also a factor in ensuring endorphins' production in a person, and it is greatly increased by using smart technology, without the hassle of changing the environment element manually.

The research qualitatively concludes that endorphin-stimulating architecture is possible. However, a blood test to measure endorphin level is needed to establish a firm conclusion. This is usually conducted in medical research that requires a careful approach because respondents subconsciously feel uncomfortable with an invasive blood test that affects the endorphins generation.

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