

Multisensory Perception Of Architectural Design

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Abstract

Architectural design goes beyond just constructing buildings, it is also an intriguing interplay of form, function, and beauty that engages the senses and shapes how we perceive space. Architectural settings have a significant influence on our feelings, actions, and general well-being. Our impression of these environments is greatly influenced by our sensory experience, and some design choices might elicit particular feelings and reactions. The purpose of the study is to understand the human senses and how architectural design impact their perception of space. This review work discusses the substantial sensory impacts caused by architectural design features, focusing on how olfactory, tactile, visual, and aural inputs can affect how people perceive things. It explores the complex relationship between design features and the subjective and cognitive reactions they elicit in occupants through a peek at various research papers. This paper gives a thorough analysis of how efficient design decisions may improve the human experience and produce settings that strongly resonate with their users, from the play of light and shadows to the acoustics that fill the air. The process will include understanding the various human senses and how architectural design stimulates the senses that in turn affect how we perceive a respective architectural space. This includes understanding, reviewing, collecting, and comparing data from selected research papers across the world relating to user experience and the hospitality sector. The paper focuses on shedding light on how sensory-driven design may help create a more immersive and aesthetically pleasing built environment based on the discussions on the research findings. Finally, it will conclude all the discussions and findings to motivate future design methodologies that emphasize the multisensory elements of architecture, resulting in environments that have a good and enduring impact on those who use them.

Key Words: Human senses, multisensory, perception, architectural space.

1.0. INTRODUCTION

Humans initially perceive space based on their visual sense and then all the other senses. Every design element in the architectural space is crucial as they potentially impact the senses of the users and the way they feel and respond. Well-designed spaces have the power to do more than just provide a practical workplace; they may arouse feelings, build enduring memories, and alter how people view a company or place of business. In order to improve the overall ambiance and user happiness, researchers and designers have come to realize how critical it is to take the sensory impact of design aspects into account. Design ideas that go beyond aesthetics and incorporate sensory elements need to be the key tactic for creating distinctive architecture. In order to illustrate the influence of sensory design aspects, the review paper will look at empirical research papers about humans and senses from an architectural perspective.

The purposeful integration of different sensory experiences, such as sight, sound, touch, and smell into the design of a constructed space is referred to as multisensory perception in architecture. This strategy acknowledges that individuals interact with their surroundings through a variety of senses, and that by appealing to these senses, architects can design more holistic, immersive, and engaging places that accommodate the various ways that people perceive and interact with their surroundings. The major sensory effects of architectural design elements are discussed in this review work, with an emphasis on how olfactory, tactile, visual, and auditory inputs may change how individuals perceive things. In order to help designers and architects create environments that are not just aesthetically pleasing but also intensely immersive and unforgettable, the paper will analyze how architectural spaces might be structured to induce particular feelings and responses. The purpose of the study is to comprehend the senses of people along with the way they respond to built environments.

2.0. METHODOLOGY

A preliminary literature study was performed on human senses and perception before choosing research papers to gain an understanding of the status of the field's knowledge at the time. A list of relevant keywords and phrases that align with the research was developed that includes terms related to architectural design, sensory perception, and related concepts.

Recent research papers and review articles published in journals between 2017 and 2021 were considered. The study of research papers and assessing the quality and intended research findings are based on four considered human senses for this study and their relation to the perception theory. The literature review included reviewing the research papers and deciding the subsections/subtopics for the review paper, setting the parameters of the study, and reviewing the papers based on the subtopics set. It includes a discussion on the four senses mentioned. The paper concludes with findings and discussion based on accumulated and comparative study of the research papers including suggestions for potential future research directions.

3.0. ARCHITECTURE AND THE MULTISENSORY MIND:

The fascinating assertion made by Le Corbusier was that architectural forms "work physiologically upon our senses." Since the twentieth century itself, architectural, psychological, and cognitive research has always focused on a single sensory attribute – vision. Far less attention has been given to other sensory impacts individually. Until later, little consideration has been given to how senses interact, with one another and how they altogether impact an individual in space. But, the latest studies prove whether or not we are aware of the influence of the many senses that are being aroused, it will always be the end consequence of that combination. Given that those of us who live in urban environments—which, as we've seen, is now the majority of us—spend more than 95% of our time indoors, architects have at least some responsibility for ensuring that the built environment's multisensory features cooperate to deliver an experience that positively stimulates the senses and, by doing so, facilitates rather than interferes with our well-being (Spence, 2020).

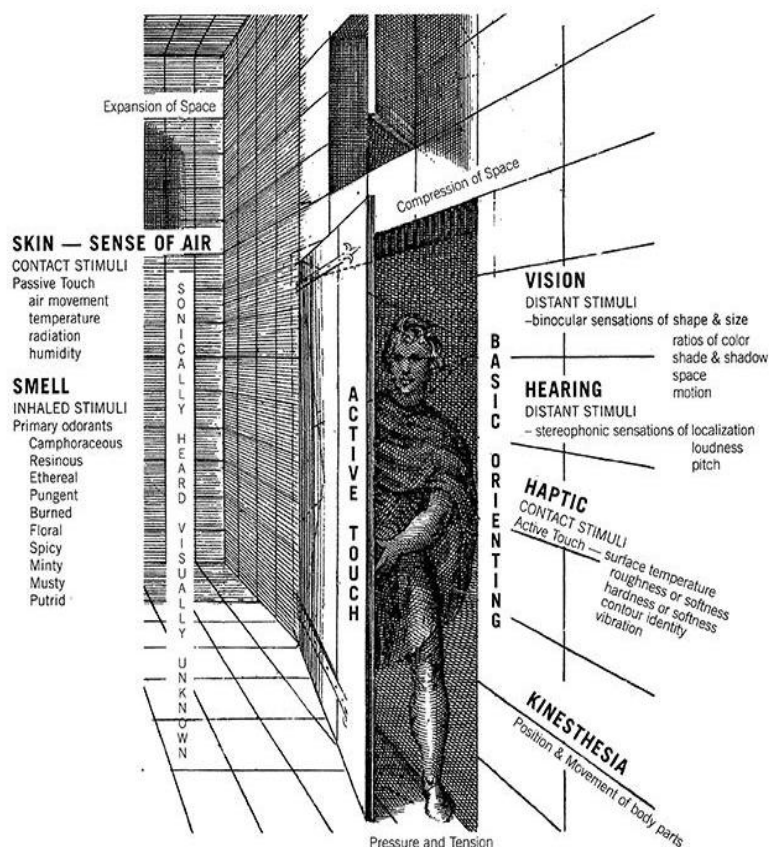


Fig. 1. Joy Monice and Frank Vodvarka, Ranges of the senses, from the Sensory Design. (Source: Sensorial Design Approach In Built Environment; JETIR 2021)

The connections and relationships between people should always come first when building space, according to architects. These senses enrich the human experience and provide people access to their memories. The ability to measure qualities of substance, space, and scale exists in each of the following: the eye, ear, nose, and skin (considered for this review paper only). The principles of architecture suggest that a stronger sense of one's place in the environment may eventually lead to a stronger sense of one's own identity (Shakthi. K, 2022).

4.0. ARCHITECTURE AND PERCEPTION

Perception is a feeling-based process that involves further organizing, recognizing, and interpreting sensory data to help people express themselves and comprehend their surroundings. On the foundation of sensory input, perception adds the subjective elements of time, thought, and memory (Hui Yu, 2018).

4.1. Visual Perception—Coincidentally Borrowed

Vision is the straightforward presentation of things. However visual perception is the psychological control, understanding, primary judging, processing, and cognition of the aspects of shape, colour, substance, and light in space (Fig. 2, Fig. 3). Coincidentally adapted to interior design, it can stimulate the human visual perception function. The hotel's interior designer uses elements like component modelling, decoration, material, and colour that can immediately stimulate the senses and encourage users to explore the area. Only in this way can the limited space be infinitely expanded, and the aesthetic and visual feelings of the area are improved. (Hui Yu, 2018).

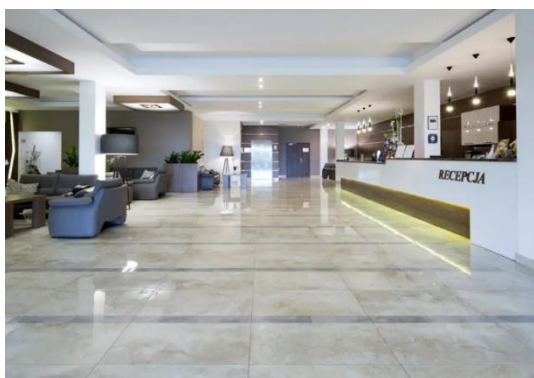


Fig. 2. Borowy Dwór Biznes & SPA, Poland
(Source: Paradyz ceramica)



Fig. 3. Reception visualization
(Source: How to Create a Reception Area to Wow Your Visitors-Technical signs)

4.2. Space-Time Perception—Dynamic Experience

People can learn about their surroundings indoors by changing their position and timing. As time and space are combined, and as space moves, time is embodied, the idea of "space-time" is born. There are three ways to enhance hotel interior space-time perception:

- i. Select regionally inspired materials for the hotel's interior design or select decors, materials, and furniture of a theme with time memory (Fig.4).
- ii. Create "linear" space, for instance, by utilizing hallways, and traffic areas, linking the intersections of various rooms, and providing space mobility (Fig.5).
- iii. To maximize the perception and sensation of indoor space, we can employ continuous ceilings or increase a sense of order with the contrast of high and low, dark and light, straight and simple.
The contrast between "light" and "dark," "wide" and "narrow," "real" and "virtual," "real" and "moving," and "wide" and "narrow" enhances people's perception of space-time (Hui Yu, 2018).



Fig. 4. Hotel of Rajasthan
(Source: World Travel Magazine)



Fig. 5. Office space-Linear corridor leading to hall
(Source: /tomorrow)

4.3 Logical Perception—Associative Inference

Condensed thinking is where reasoning is developed. It is the stage of the spatial emotion experience that is most intense. Additionally, people's perception of the world is a complementary and intense reaction process. It is an entirely irrational thought process. Logical perception is the user's self-feedback and is an expression of perception that has been altered by experience (Hui Yu, 2018).

5.0. SIGHT AND ARCHITECTURE

The sight of form we receive impact the perception of how the place is – small, large, linear, tall, clean, light, dark, open, enclosed, cosy, welcoming, uninviting, etc.

5.1. Influence of Form/Shape

Two identical lines run parallel to one another in rectangular rooms. The linear structure creates a sense of spatial stability for the viewer. Since rectangular rooms are static and unyielding, adding 3D items can boost their movement. Modern room architecture is dominated by rectangular rooms, especially those used as bedrooms, living rooms, and baths. Without a beginning or an end, circular areas are thought of as ideal shapes. It creates balance and cohesion, offers strong energy, and improves the visual space in a room when combined, whether as a nook or as the shape of the space (Al-Zamil, 2017). Curvilinear forms are often rated as being more accessible than rectilinear ones. An avoidance response may be slightly more likely to be elicited by angular forms, especially those that point downward or toward us. The height of the ceiling has also been shown to exert an influence over our approach-avoidance responses. Higher ceilings make the space look open and greater even if it's not, however lower ceiling make the space look enclosed. However, here it should also be considered that the visual perception of space is significantly influenced by colour and lighting (Spence, 2020).



Fig. 6. Perception of curvilinear vs. rectilinear spaces along with high and low roof.
 (Source: Senses of place: architectural design for the multisensory mind by Charles Spence)

5.2. Lines and perception of space

A room's psychology is impacted by lines. Different kinds of lines are used by interior designers to evoke a certain atmosphere or ambiance in a space. Vertical lines often extend beyond the observer's field of vision, giving the impression that the room is taller than it actually is. However, overusing vertical lines gives off a claustrophobic or uneasy vibe. Vertical lines provide the impression that a room is higher than it actually is because they make it appear smaller on a level. Vertical stripes of different colours, as well as vertical ornaments or patterns against the wall, can be used to visually raise a room. Additionally, it is possible to arrange paintings, vertical divisions, and other visual elements such that they look like vertical lines. Horizontal lines broaden the room making it appear wider than it is. Additionally, both horizontal and vertical lines convey a sense of emphasis, direction, height, and anchoring (Al-Zamil, 2017).



Fig. 7. Horizontal line making room wider
(Source: Expert talk 14; Houzz)



Fig. 8. Vertical lines make room look higher
(Source: Design cafe)

5.3. Effect of light

The sun continuously modifies the colour, brightness, and focus of its light as it moves around the sky and casts a shadow on the planet. All living things on the planet, including us, have their entire beings calibrated to the cycle of sunshine throughout each day and each season. Light is necessary for our bodies' physical functions, which might impact our energy, attitude, and disposition (Agapiou, 2018).

5.3.1. Light and perception of scale and size:

The limits or zones of a specific space are frequently defined or formed using light as a building material. Although light has got no material substance, we perceive the scale and size of a space influenced by it. Light entering a building can be used as a parameter to extend the boundaries set for a building space (Agapiou, 2018).

5.3.2. Colour, materials, and light:

The way we see space can also be significantly influenced by the interaction between light and colour. Light and colour can interplay to produce potent atmospheric settings. Light can pass through coloured materials to create a euphoric visual look and can enhance the interior feel and vibe when used efficiently. Brick, wood, stone, glass, and even cloth are examples of natural materials that can individually bring out a different aspect in a spatial environment. However, it's crucial to remember that the outcome mostly depends on their interactions with light. We will be positively affected by an acceptable use of materials and the proper amount of lighting, which will pique our emotions and establish an ambiance. Various materials have various appearances in the light or in the shadows. Therefore, some materials require shading, while others require lighting (Agapiou, 2018).

5.3.3. Light and shadow:

Both light and shadow are given a significant role in architectural design. They coexist because of the interaction between light and matter. Shadows cast by material are inextricably tied to light because it contains expended light. Shadows draw attention to the existence of light, giving areas their own unique personality and exposing form, texture, and atmosphere. Designing space in a way that makes use of light to create shadows that add to the aesthetic of the interior and changes along with time, needs to be considered (Agapiou, 2018).

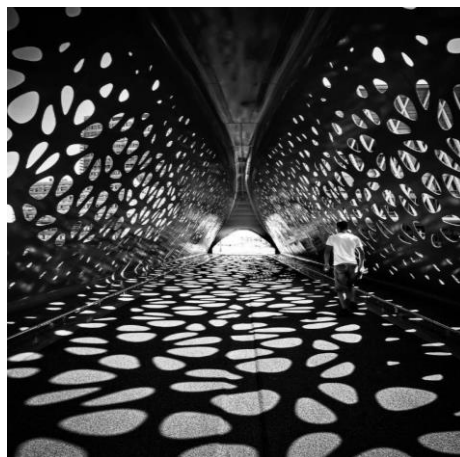


Fig. 9. Play of light and shadow
(Source: Andreas Goerss Twitter)

5.4. Colour, pattern, texture and illusions

Perception of space is highly influenced by colour. Lighter colours make a space feel spacious and more airy, while darker colours foster intimacy. It can define the boundaries/zones of a space. Darker ceilings may produce a cozier and more personal environment, while lighter ceilings may make a space feel higher (Fig.10). Contrasting colour schemes can highlight specific architectural features or artefacts and establish focus points that change how we view an area as a whole. A space's perception of equilibrium can be impacted by colours. A room might appear chaotic or out of balance if colours are used in ways that are visually off-balance or unevenly distributed throughout, which can affect how much space is perceived. Optical illusions can be made with colour. For instance, using a gradient of dark to bright colours on a wall can give the impression of depth and prevent the wall from appearing flat. A wall or surface may appear smooth or rough depending on the colour, which affects how we perceive texture and materiality (Al-Zamil, 2017).

We can perceive a space's size differently as a result of patterns. Smaller designs might give the impression that a room is larger and more open, while larger, bolder patterns can make a room seem more cozy and private. Our perception of the size of items in a place can also be influenced by the pattern proportions. Patterns can mimic materials or textures that aren't necessarily present in an area. The placement of patterns may influence how a viewer moves through and perceives a space by directing their sight along particular trajectories. Patterns may serve as focal points or places of interest within a space by directing attention there. This might direct their attention and affect how they see the scene as a whole (Al-Zamil, 2017).

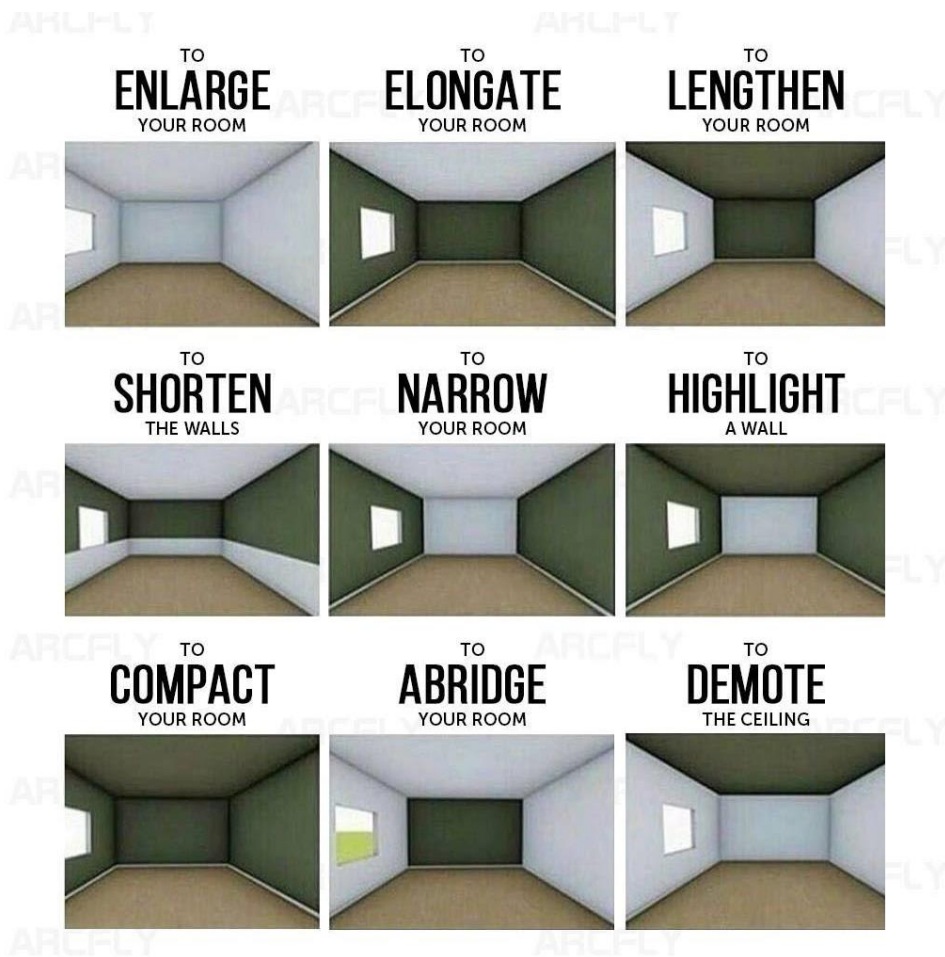


Fig. 10. Impact of colour contrast (Source: Josh; pinterest)

6.0. OLFACTORY IMPACT

Any space having poor olfactory or poor indoor air quality may cause sick building syndrome. To maintain a regular normal smell in a space, **natural ventilation** is the prime factor. Second, the building materials should not omit toxic pollutants. Many people who reside in ventilated buildings with locked windows feel that they have little control over their multisensory environment, and this sensation may contribute to the development of SBS (Spence, 2020).

Perception and feelings inside a space change with regard to the emphasis placed on olfaction. A study of the Barclays Center arena in Brooklyn, NY shows when it first opened in 2013, a number of press commentators called notice to the peculiar, though not instantly recognizable, aroma that seemed to permeate the area and that looked to have been put on purpose, almost as if it were supposed to be a hallmark scent for the location (Spence, 2020).

Pleasant scents can be maintained by artificial methods or the smell of indoor plants can also be ensured to make indoor spaces appear, clean, lively, and welcoming. The diffused smell should match the local environment's naturally occurring, nature-based scent to create the impression of fresh air, and by extension, cleanliness (Zehrer, 2021).

7.0. SOUND-AN INVISIBLE ARCHITECTURE

Without sight, sound can aid with our understanding of the environment, as well as its function and parts. Sound is often concerned with noise and how to eliminate it. Acoustical changes can have a big influence on the exterior (Shakthi. K, 2022).

7.1. Visualizing space through sound

Hearing's significance in how we perceive space is typically underrated. However, sound is the ingredient that prompts our eyes to picture the environment we are in. Spaces in an architectural environment have a sound, even the sound of water droplets in the night may sculpt a volume into the black vacuum. Through the magnitude and physicality of that specific empty space, the stillness and emptiness of the vacuum may have its own sound. Our ears are affected by a given architectural location's length, width, and shape. In the backdrop of our minds, music stays as an unconscious experience that stimulates our sense of seeing. A distinctive sound is connected to a building's shape, its materials, and the way they are arranged. When compared to the softer sound of a lively space, which is produced by the numerous things that belong to the residents, we can quickly recall how harsh an empty, deserted space sounds (Agapiou, 2018).

Soft music will create a feel of relaxation and a welcoming vibe. Water features that create sound connect the people to nature and may add volume to the space. While no music or silence can be help concentrate in working spaces, gym or workout spaces must include fast music that impact our mind accordingly.

7.2. Need for tranquillity

Our hearing gets "blinded" by the background noise that permeates every aspect of our daily lives. A headache and other stress-related symptoms may be brought on by a loud, continuous noise. An immersive aural experience in an architectural environment has the capability to drown out all outside noise and let us feel a part of the place we're in. One of the most striking audio impressions is peace in architecture. This feeling can be executed in zones where we need relaxation, like hotel rooms. Proper acoustic treatment at required halls is also necessary to keep our focus on the particular activity (Agapiou, 2018).

8.0. TOUCHING SPACE

8.1. Haptic/ Active touch- Vision for the skin

Buildings are above all physical objects, even if architecture is frequently characterized in terms of abstractions like space, light, and volume. The texture of brick, the veined surface of marble, the cold precision of steel, and the grain of wood all contribute to the tangible experience of architecture (Spence, 2020). When designing significant and memorable settings, the tactile sense should not be overlooked. The sense of touch is involved in determining the weight, density, texture, and warmth of an architectural environment as well as feeling a smooth or rough surface. Touch is more reliable and less prone to error than eyesight. Tactics can detect closeness but vision can only see distance (Agapiou, 2018).

While various structures have an impact on our eyesight, we can feel their structural components when we touch them. The density, texture, warmth, and weight of materials that may not appear to differ visually may all be read by our skin. We learn more about things by touching them than by simply gazing at them. We can feel the smoothness or roughness of the ground underneath us. With our soles, our knees when we kneel, and our entire body when we are lying down, we trace its texture. In fact, even if we are not aware of it at the time, we start to have an instantaneous experience of a particular location the moment we touch the door handle to enter it. As a result, touching space encourages our bodies to engage with all the architectural components, resulting in a richer experience than simply looking at them (Agapiou, 2018)

8.2. Passive touch

Ultimate feeling and comfort which is a prime factor in how we perceive space depend on the temperature, humidity, and air movement of the built environment. Our impression of a space is greatly influenced by the temperature and humidity in that location. They enhance our convenience, health, and overall pleasure. The ideal temperature range, which is usually between 20 and 25 degrees Celsius, creates a comfortable atmosphere that affects our mood and productivity. Warmer temperatures frequently encourage socializing and relaxation, while colder ones could encourage attention. Balanced levels of humidity (between 40 and 60 percent) prevent skin dryness and uncomfortable breathing and influence how comfortable people feel. Low humidity can cause discomfort, while high humidity might feel oppressive and interfere

with heat regulation. When combined, temperature and humidity have an effect on how we use a place, affecting our ability to relax, focus, and have a good time. A location becomes more welcoming, practical, and pleasurable when it is designed with careful consideration of these characteristics (Topaloğlu, 2016).

9.0. FINDINGS

The sensory impact of building and design elements significantly impacts the perception of hotel spaces. Visual aesthetics, acoustics, tactile elements, olfactory elements, all contribute to the overall sensory experience. Visual aesthetics set the tone for the entire experience, with colors, lighting, textures, and overall design style influencing guests' perception. Aural elements, such as background music, acoustics, and noise levels, affect mood and comfort, while tactile elements, such as textures and materials, evoke indulgence and relaxation. Olfactory elements, such as signature scents, evoke powerful emotions and memories, while gustatory elements, such as the quality of food and beverages, contribute to a unique and memorable experience. Spatial layout and flow also influence guests' navigation and interaction with the environment. Intuitive wayfinding, open spaces, and well-defined areas for various activities contribute to a positive experience.

Natural elements, such as plants, water features, or outdoor spaces, create a sense of connection with the environment and promote relaxation. Natural light also plays a significant role in enhancing the ambiance and mood within the space. Cultural and local influences, such as local artwork, traditional motifs, or indigenous materials, provide a unique and authentic experience. Personalization, such as customized room amenities or tailored experiences, make users feel valued and enhance their emotional connection with the space. The successful design of any building space must take into consideration all these sensory elements, creating a harmonious and immersive environment that resonates with guests' emotions, preferences, and desires.

10.0. DISCUSSION

This article focuses on the main design features that can increase the feel of built environment. It demonstrates that design can change people's perceptions through strategic manipulation of spatial configurations and treatments. Colour, whether through paint, furniture, wallpaper, or natural material cladding, is an integral part of interior design. However, designers should recognize that certain colors and patterns impact the human perception of spaciousness. With the availability of artificial light, designers must focus on controlling natural light and choosing and locating artificial light. Lighting levels also play a significant role in creating spaciousness awareness. Interior designers must consider the shape, form, and volume of spaces, considering their impact on users of space. Floor plans and room volume are also significant factors that influence how humans perceive spaciousness.

Designers play a crucial role in shaping the shape, form, and volume of spaces, considering the impact on users. Floor plans and room volume are both significant factors in determining spaciousness. Designers aim to fulfill functional, aesthetical, and cultural requirements, with privacy being a major design limitation. The physical properties of space, such as openness, permeability, and connectedness, are essential for functional success and also influence spaciousness positively and negatively. Understanding the crucial role of sensory impact may enable the hospitality sector to design memorable and engaging visitor experiences. Hotels may create enduring impressions, encourage client loyalty, and eventually improve the image of their whole business by carefully managing the sensory aspects of their venues. Utilizing the sensory potential in a competitive environment improves client happiness and helps the hotel develop a unique and lasting brand.

11.0. CONCLUSION

In conclusion, including multimodal perception into architectural design is a revolutionary idea that takes into account the various ways people interact with and perceive their environment. Architects build immersive spaces that go beyond simple utility and provide occupants and users with a comprehensive and fulfilling experience by purposefully appealing to sight, sound, touch, smell, and even taste. Architects create rooms that elicit emotional reactions, direct movement, and develop a sense of connection by carefully balancing materials, textures, lighting, acoustics, and spatial arrangements. Additionally, this strategy emphasizes the value of user-centered design, where people's preferences and requirements are recognized and taken into account during the creative process. Architects provide inclusion and accessibility by considering cultural, emotional, and universal design concepts, creating places that are friendly to a variety of people.

Multisensory design improves not only the aesthetic and practical features of architecture but also the well-being and quality of life of individuals who use these places. Architecture develops into a medium that not only provides shelter but also inspires, engages, and resonates on a profoundly human level as the lines between form and function become increasingly hazy. Architecture's pursuit of multimodal perception is an example of creativity, empathy, and innovation, and it has the potential to create a cohabitation that is both peaceful and meaningful between people and the built environment.

12.0. REFERENCES

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