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# Saving Environment in Architecture Design through Illusion Method: A Literature Review

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**Keywords:** Architecture Design, Environment Impact, Green Architecture, Real and Virtual, Urban Environment

**Abstract.** Architecture deals with solving problems through building design, including environmental issues. This study focuses on and analyses the architectural illusion design to save the environment. Therefore, applying this illusion approach manipulates the area of the environment, which directly affects the user's living. The purpose of architectural illusion in the design is to impact the environment significantly. This study method reviews the relevant literature that provides solution strategies for a design without using illusions. These solutions are then compared using illusions to determine the differences in environmental saving. The result is that designs that apply architectural illusions will benefit the environment and not threaten the environment.

## Introduction

Architectural design is a relationship between 3 balances: strength, beauty, and utility [1]. Issues in architecture are constantly changing from time to time. Nowadays, the environment is considered essential to architecture [2]. Meanwhile, the environment is needed to construct an architectural design as a medium and forming element. Therefore, an architectural design must now be able to protect the environment significantly [3].

In the field of architectural design, the environment is a crucial imperative. This constraint demonstrates that the approach to resolving this problem is still evolving [4]. One role in resolving these issues is the employment of technology, which is entirely efficient. Technology use has drawbacks, one of which is that it consumes energy to function. However, there must be a technologically free method of addressing the urgency of the environment in architectural design. It is designed to accomplish the main goals as effectively as possible [5]. Some scholars suggest using passive design in architecture to address the issue and safeguard the environment. Although this method does not involve technology, not all design fields can use it. There are unfavorable environments for many architectural ideas [6].

By contrasting architectural designs that use illusions and those that do not, this study aims to show how illusions are used in a design. This invention gives architectural designs a high level of effectiveness in preserving the environment, especially those in limited environments. Illusion in an architectural design can prevent environmental problems without using technology. All that needs to be done is to arrange the elements [7]. The bibliometric analysis of Vosviewer reveals that the subject matter of this paper has not frequently been studied (Fig. 1).

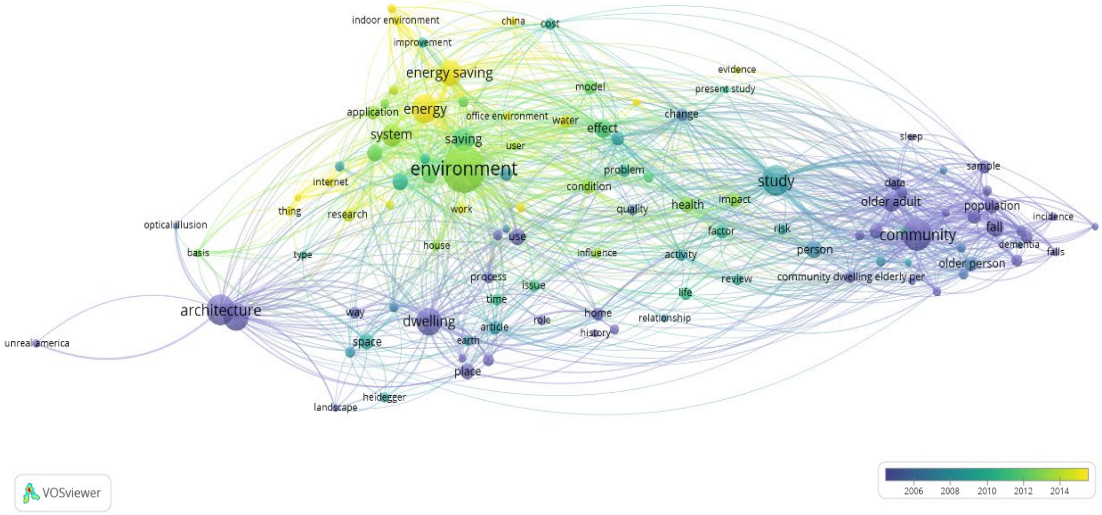


**Fig.1.** Vosviewer as bibliometric mapping

This structured narrative review aims to explore the frameworks used to investigate the method of illusions to save the environment on design, the methods employed, and whether the experiments found evidence in support of the framework. The combination of illusion and architecture can find new ideas supporting saving the environment.

## Methods

By literature review, this method compares sources before comparing dwelling-related environmental protection solutions that employ deceptions and those that do not. A literature search was conducted using Mendeley and the search engine Google Scholar to find research that reports both manipulations of the visual environment with illusions (Fig. 2). Included in the list of keywords and phrases are environmental architecture, ecology architecture, illusion architecture, dwelling, or dwelling environment. No limitations on publication date, study design, or methodology were applied during the search carried out in May 2023.

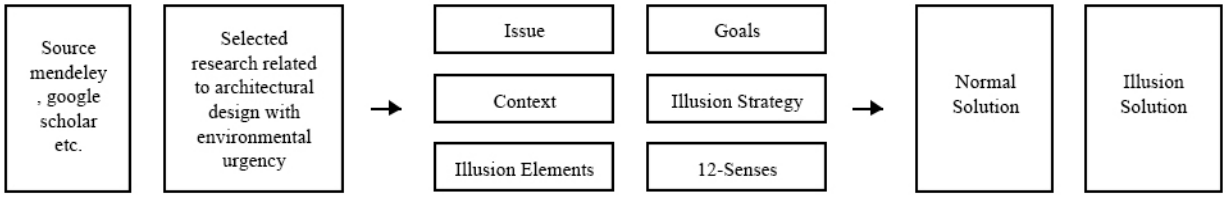


**Fig.2.** Research method diagram

This scientific article's title is based on data analysis by Vosviewer, which identifies scientific works that have not undergone extensive research. The Vosviewer is applied as a bibliometric mapping with the keywords illusion architecture and saving environment. Nothing on this level dazzles research authors, organizations, or articles. Studies based on diverse scientific papers are required for inclusion, as are studies integrating research on illusion, environment, dwelling, and other related scientific articles. The illusion method examines related articles by studying associated issues, contexts, approaches, goals, and standard solutions.

## Results and Discussions

**Environment Urgency.** The national goal is to reduce carbon emissions from buildings because they are significant in carbon reduction plans. Future concerns include the need to lessen the influence on

the environment [8]. Due to industrialization and economic expansion, urbanization significantly affects how a local area's land use and land cover (LULC) are changed. Replacing natural surfaces, including bare soil, with impervious surfaces that lessen water percolation into the ground is one of the primary changes urbanization brings. Urban areas' surface cooling rates drop due to these changes [9], resulting in decreased soil moisture and evapotranspiration. The environment is now significantly impacted by development and is eventually supplanted by it [10]. One of the impacts of not maintaining the environment is human food sources. To solve the issues of food security, science-based decision-making is essential. The public and private sector scientific community must work together to maximize a globally collaborative research environment. Policymakers and regulatory authorities must move quickly to provide a level playing field so that all researchers, farmers, and food chain participants can access the newest technologies [11]. Humans should preserve the environment so that it has a positive effect on humans. A diagram of land use in architectural design can be seen in Fig. 3.

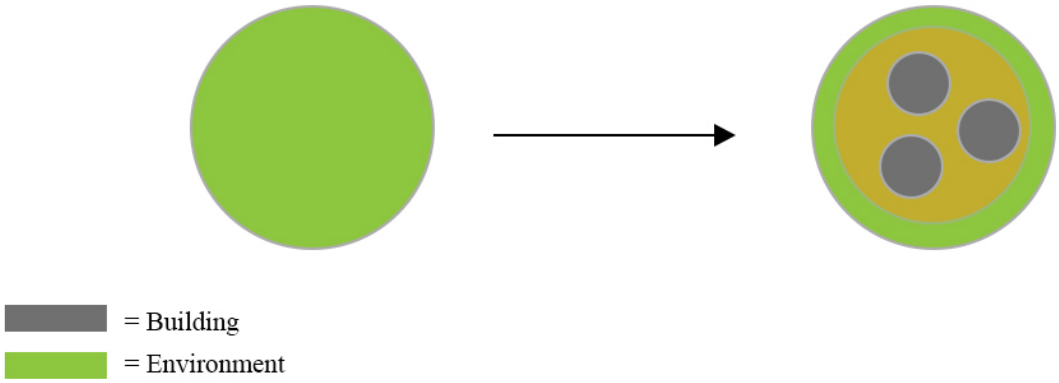


**Fig. 3.** Comparison between building and environment

Development causes a reduction in land, which damages the environmental ecosystem. Buildings do not necessarily require large land areas, but now, much land is not being used effectively. As a result, the cooling rate of urban surfaces is significantly lower than rural ones. Large amounts of waste heat and pollutants are also released into the atmosphere due to the expansion of trade, industry, and transportation operations in urban areas [12]. All of these adjustments to energy budgets result in higher temperatures in urban regions than in nearby rural areas, known as the urban heat island effect (UHI). Due to the discharge of heat from all concrete surfaces, including buildings and roadways, this phenomenon is most apparent at night [10].

**Green Architecture Principles.** Protecting the environment is everyone's responsibility. A good environment will also respond well to humans. National targets focus on reducing carbon emissions in residential areas and have an essential role in carbon reduction strategies. Reducing environmental impacts is a future architecture design issue [8]. According to [13], six principles make the presence of this design suitable for the surrounding environment (Fig. 4).


**Fig. 4.** Six Green architecture principles
Source: Green Architecture: Design for an Energy-conscious Future [13]

The six principles of environmentally friendly buildings above are a form of architectural design's concern for the environment. Architecture requires an environment to be present and provide benefits to a design. Green architectural principles in a design have become something that must be fulfilled apart from other design principles. Procedures implementing green architecture are advantageous because they will receive certification from institutions overseeing architectural design development. This certification will make the design easy to approve and difficult to debate.

**Illusion Strategy in Architecture.** The architecture of illusion is a relationship between real and virtual elements [14]. Virtual reality is presented in a real form and the real world. Illusions mainly depend on the user, their point of view, and how they perceive things. In architecture, illusion is a strategy for achieving particular objectives without the aid of technology. The illusion posture significantly impacts the material. If a material is arranged in a specific pattern, it takes on a new significance and is not just regarded as a form [15]. Illusion in architecture is very close to reality [16]. We can create an illusion with a specific purpose using our desired elements and strategy. We are arranging real aspects to form an illusion. The more an illusion deceives the user, the more influential the illusion is in a design. The illusion exists in the glorious moment of hesitation when we examine our realities and reevaluate our expectations, frequently leading to discovering a new adventure and an ideal equilibrium. Something seems to settle as if it suddenly feels like the appropriate course of action [7]. The illusion strategy in the above table demonstrates six techniques for applying illusions to various aspects. This strategy will be contrasted with other environmental protection strategies. Solutions from different literature will be used to compare the effectiveness of using illusion in architecture for environmental protection (Fig. 5).

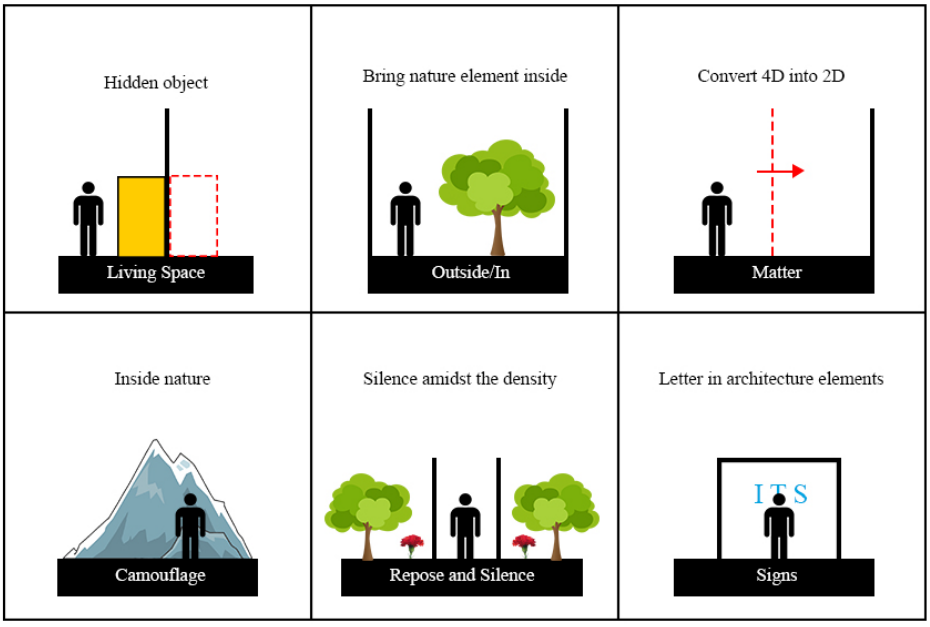


**Fig. 5.** Camouflage, living space, matter, outside/in, repose and silence, signs as illusion strategy in architecture. Source: Illusion in Design: New Trends in Architecture and Interiors [7]

The six illusion strategies above can be used in the context of protecting the environment. An illusion applied to an architectural design can directly affect the user. The relationship between the environment and users can be modified so that users can use land efficiently. The following is an explanation of the six illusion strategies:

1. Camouflage

When it comes to camouflage, the projects chosen don't just aim to blend in with their surroundings or fool the sight for the sake of deception but also more significant objectives of user engagement. Architecture will be concealed using this camouflage technique as an object in the surroundings to meet a purpose.

2. Living Space

At its root, the illusion is an invitation. Suppose we can comprehend it, which takes thought, knowledge, and curiosity and opens doors to the unexpected. In architecture, concealing is always done with a view toward efficiency while also serving a practical purpose. This strategy for creating living space makes efficient use of available areas. Residents can use a space that can serve multiple purposes and has interiors that can change or be hidden.

3. Matter

It is no longer unusual for furniture to sell at auction for the same price as or more than a work of art by a well-known artist. Furniture may shape itself around the experiences and expectations of every consumer and is just as interpretative as any area used by the body. An expression of the furniture industry's evolution. The idea is to use this way to make something impossible in furniture to be present. The matter process will provide a fantastical element to furniture design.

4. Outside/In

In this part, illusion investigates unconventional approaches to combining site elements with interior architectural design. Shelter, security, and property management serve their fundamental purposes, but only with some interruption or even unrest brought on by conflicts over primacy. This approach focuses on entering something externally and is perceptible from within the structure. Residents might feel a sense of oneness with the surrounding environment by choosing transparent materials.

5. Repose and Silence

The favored acoustic for relaxation is quiet, and strangely, the acoustics of silence are rather complex. It is not possible outside. Outside, one cannot be alone. There are thus two different types of seekers: one yearns for firmness and silence, and the other yearns for movement and passing screams of the natural world. This approach is mainly concerned with silence. This approach aims to create a design that can accommodate this requirement.

6. Signs

There is just one way to view this illusion. Several architectural components typically used to display writing, graphics, etc., present illusions. This deception aims to insert another dimension into our own instantaneously. The strategy can be a marking on an outside architectural design, which is highly helpful in marketing.

As an example of its application, the following two buildings demonstrate the use of the illusion method in architectural design: *Singha D'luck Theatre – Thailand*, the Illusion material is used in this design. To make it happen in reality, illusion support theory is used. When viewed from a particular angle, the structure seems transparent due to the addition of mirrors to its walls. *Tree Hotel – Sweden,* this concept is for a house in a forest. This design location is supported by a tree that is 8 meters high. This building's glass walls use virtual materials to give the impression of transparency and environmental friendliness without using additional colors. Illusions addressed to the user must

certainly look as real as possible. In implementing an illusion, the elements that form it are needed [17]. This can be seen in Table 1.

**Table 1.** Illusion elements in architecture
Source: Art and Visual Perception: A Psychology of the Creative Eye [17]

| No. | Illusion Elements |
|---|---|
| 1 | Balance |
| 2 | Shape |
| 3 | Form |
| 4 | Growth |
| 5 | Space |
| 6 | Light |
| 7 | Color |
| 8 | Movement |
| 9 | Dynamics |
| 10 | Expression |

This illusory element is an application object, and the elements can form a design. This strategy makes the details a sub-section in implementing the illusion, which aims to save the environment. The illusion that is felt is undoubtedly different for everyone, but the designer only has one intention and purpose in presenting this illusion. Until now, it cannot be judged by the 12 sensors. This happens because the application of illusion has not been able to replace complex real elements. In this design, the illusion presented can be felt by 12 human sensors (Fig. 6.).

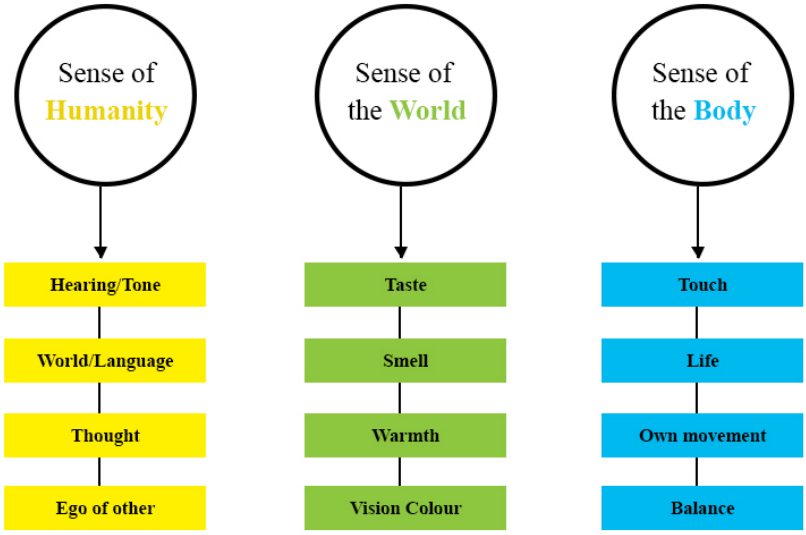


**Fig. 6.** 12-Sensory
Source: Steiner and Goethe: Circle of Senses [18]

Sensory is divided into 3: sense of humanity, sense of the world, and sense of the body. This 12-sense is a more detailed division than the 5-sense we generally know. For example, one organ in the body can feel several different senses, including the skin, which can feel temperature and touch with different feelings. These three senses represent human nature in the scope of social interaction, namely when alone (sense of the body), family (sense of the world) and the public (sense of humanity). 12-sensory will be the main target in applying illusion architecture to a design. An illusion that all 12 senses cannot currently perceive. Therefore, this research uses a combination of illusion theory so all 12 senses can feel the illusion. A module is proposed to provide direction and convenience when applied to a design to convey the illusion in an architectural design. How an illusion architecture is formed can be seen in Fig. 7.

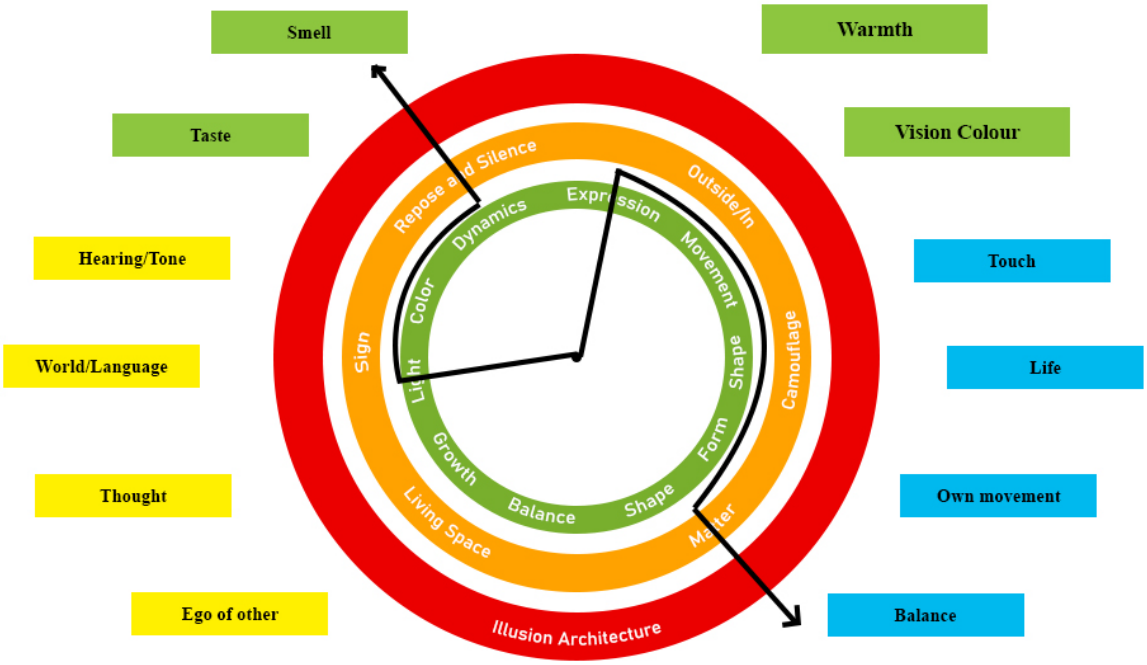


**Fig. 7.** Illusion method in design

The illusion module is proposed to facilitate the application of architectural illusions in a design. Starting from determining the illusion element (in the middle of the diagram), this purpose is based on user and land analysis. Then, select the illusion strategy that suits the specified elements and determine what sensory you want to focus on presenting. Sense is presented as a whole, but determining sense is used as a reference to its presence in general. Each zoning can be carried out at the same stages. Different zoning and architectural illusion approaches can be based on the architectural design module.

**The Effect and Strategy to Save Environment with Illusion.** Architecture design significantly impacts the environment in terms of issues, context, challenges and aims, strategy, and theory. The following explanations of the connection between housing and the environment are taken from several sources and can be seen in Table 2.

**Table 2.** Summary of the effect of dwelling on the environment

| Source | Issue | Context | Goals | Normal Solution | Illusion Elements | Illusion Strategy | 12-Senses | Illusion Solution |
|---|---|---|---|---|---|---|---|---|
| [19] (Andersen, 2009) | Natural energy in dwelling | Bringing air into the building | Dwelling requires air exchange | Create space for air circulation | Space | **(Outside/In)** | Touch | Bringing air inside with air movement illusion |
| [20] (Ishikawa, 2012) | Urban green in dwelling environment | Effect green space | Green spaces improve the working environment | Built Indoor garden | Balance | **(Matter)** | Smell Life | Illusion visual for indoor space |
| [21] (Kalibatas, 2011) | Dwelling attributes to users | Indoor attributes of dwelling | Defining attributes of dwelling | Element to get positive attributes | Dynamics | **(Outside/In)** | Warmth | Using illusion to guide the attributes inside |
| [22] (Gamaldo, 2015) | Dwelling environment effect | Sleep duration in dwelling | Dwelling for a rest place | Isolation dwelling | Light | **(Repose and Silence)** | Ego of other | Illusion to give 12-sense of a suitable dwelling |
| [23] (Ishikawa, 2015) | Environment dwelling for live relocation | Being close to the place of daily activities | Dwelling criteria are good to move into | Build suitable dwelling | Shape | **(Repose and Silence)** | Life Own movement | Illusion of distance for activity place |
| [24] (Bian, 2022) | Strategy and the Rural Revitalization Strategy | Exploration of the design rules of traditional residential | Comfortable residential environment | Optimized design of indoor thermal environment | Movement | **(Outside/In)** | Warmth | Bringing in the outside elements by not adding land use |

| Source | Issue | Context | Goals | Normal Solution | Illusion Elements | Illusion Strategy | 12-Senses | Illusion Solution |
|---|---|---|---|---|---|---|---|---|
| [25] (Hidayat, 2017) | Densely populated settlements | Lower-middle-class urban community | Use a natural building system | Using natural elements as the primary energy source | Expression | **(Outside/In)** | World/language | Using mirror reflection to include natural light |
| [26] (Mao, 2023) | Regional Local Architecture | The impact of traditional culture | Use environmental factors on survival | Provide the best location for dwelling for survival purposes | Shape | **(Camouflage)** | Vision colour | Located in an area that does not have an environmental ecosystem |
| [27] (Palazzo, 2022) | Flood in urban areas | Allocating space to fluctuating water levels | Constructed ecology principle in design | Landscape architecture to avoid flood levels | Movement | **(Repose and Silence)** | Own movement | Controlling flood level by design |
| [28] (Rahayu, 2017) | Energy efficiency coffee design | Coffee agrotourism design | Attract the attention of visitors | Cut and fill the area | Dynamics | **(Repose and Silence)** | Thought | Designing in contoured areas |
| [29] (Salgin, 2017) | Implementing sustainability to architectural developments in technology | Vernacular architecture | Contribute to improving sustainability in construction | Design following the vernacular architecture | Form | **(Outside/In)** | Vision colour | A design that has no boundaries between outside and inside |
| [30] (Zahrah, 2018) | Conservation of river | Rehabilitate the area from physical | Optimum land use | Utilizing area gardening on floodplain a river as a communal area | Growth | **(Repose and Silence)** | Warmth Smell | Designing rest areas in communal areas |
| [31] (Rahman, 2017) | Place of Recreational Education on science and technology with environment | Preserving the environment | New tourist destinations with an educational theme | Focus on environmental adaptation, conservation of ecological element | Shape | **(Camouflage)** | World/language | The mass of the building blends in with the surroundings |
| [32] (Surya, 2016) | Environment restore | Ecological urbanism on heritage site | Integrating nature with architecture | Use nature and ecology element | Balance | **(Repose and Silence)** | Balance Life | Designing a resting place in a crowd |
| [33] (Jasper, 2020) | Influential agents over urban space | Music and place | The sound produced is friendly to the environment | Combine between sound, modernity, and urban space | Expression | **(Matter)** | Hearing/tone | Creating artificial sounds |
| [34] (Kanuch, 2022) | Saving energy in the apartment building | Conservation energy | Gain energy from sun heat | Photovoltaics panel | Light | **(Outside/In)** | Warmth | Using a mirror to reflect sunlight |
| [35] (Shagiakhmetova, 2021) | Reduce the negative impact on the environment | Energy efficient system | Get energy with rainwater harvesting and solar electric plant | Built rainwater and solar panel system | Balance | **(Camouflage)** | Own Movement | Hide utility system with architecture elements |
| [36] (Sabrina, 2018) | Community environment and quality of life | Thermal comfort with rainwater | Rainwater to cool down the building's thermal | Built rainwater path to spread the whole building | Shape | **(Repose and Silence)** | Warmth | Making a silent rainwater system to convert into energy used in the building. |
| [37] (Nielsen, 2020) | Medical health on office building | Open plan vs. cellular offices on mental health | To get a better organized office | Create an open plan and organize the office interior | Expression | **(Matter)** | Vision colour | Creating a virtual environment to reduce stress level |
| [38] (Lindsay, 2003) | Malaria mosquitoes affect human health | Improve health qualities | Reduce malaria mosquitoes in house design | Screen ceiling material to catch malaria mosquitoes | Movement | **(Matter)** | Vision colour Smell | Creating lavender vision and smell to reduce malaria mosquitoes |

| Source | Issue | Context | Goals | Normal Solution | Illusion Elements | Illusion Strategy | 12-Senses | Illusion Solution |
|---|---|---|---|---|---|---|---|---|
| [39] (Dan, 2016) | Energy efficiency in building | Use climate to reach efficiency in building | To reduce the energy cost of building | Built passive house design to get natural energy | Dynamics | **(Outside/In)** | Life | Making all materials on the building to gain natural energy |
| [40] (Sani, 2012) | Non-architectural factors on house design | Another component of house design | Collaboration with other components of architectural design | Implemented other components to architectural design | Balance | **(Living Space)** | Life | Combination other disciplines' components to architectural design |
| [41] (Ifani, 2019) | Tourism attractive design | Promote gayo culture in building design | Design can be attractive in tourism | Implemented gayo element on building design | Shape | **(Camouflage)** | Touch | Making a building in the center of the coffee farm |
| [42] (Al-Anzi, 2010) | Poor thermal orientation on building design | Solar-conscious design of residential building | Reduce build energy | Built shading to protect the building from solar heat | Shape | **(Outside/In)** | Warmth | Placing natural environment as shading to protect building from solar heat |
| [43] (Almusaed, 2019) | Energy efficiency on house design | Define an efficient method of building to get efficient energy | Holistic design to relate thermal comfort and economic factors | Arrange architectural elements to reach efficient energy with minimum cost | Space | **(Living Space)** | Own movement | Building flexible elements to get natural energy to achieve excellent efficiency in building design |
| [44] (Wang, 2009) | Zero energy building on house design | Create renewable energy ecosystem in building design | Maximize using natural energy | Use a solar hot water system | Growth | **(Outside/In)** | Light | Direct sunlight to the whole building to get natural light |
| [45] (Meutia, 2021) | Achieving Thermal comfort in building design | Vernacular house in Gayo, Aceh | Gayo house design can give internal thermal comfort to the occupant | Investigating Traditional Houses in Gayo | Form | **(Camouflage)** | Expression | Using nature as support to gain energy efficiency in vernacular building |
| [46] (Rizal, 2022) | Covid-19 Post Pandemic | Design housing on post Covid-19 pandemic | To reduce the transmission of the virus | To build a cooling system to reduce virus spreading. | Space | **(Outside/In)** | Balance | Let natural elements come inside the building |
| [47] (Ghaziani, 2021) | Biophilic focus on school design | Biophilic design on mental health | Evaluate biophilic design patterns | To make design patterns can be used in school buildings | Space | **(Matter)** | Thought | Bringing natural elements into the classroom to gain mental health |
| [48] (Ariani, 2015) | Influence of school design on student performance | Create outdoor spaces for students | To find a better learning space | Built characteristics of physical learning space | Movement | **(Matter)** | World/Language | Creating an environment on class walls to improve students in saving the environment |
| [49] (Peters, 2020) | Biophilic architecture design | University learning environment | Improve quality of life and learning | To get a better place, lighting, and ventilation | Form | **(Outside/In)** | Own movement | Building outdoor classrooms around natural elements |
| [50] (Candido, 2019) | Open plan office to know each other | Shared between people in high-performance workspaces | The social aspect of building design | Create open plan office | Expression | **(Living space)** | Ego of other | Building a flexible table for each worker. They can fold if there is no need for it |

| Source | Issue | Context | Goals | Normal Solution | Illusion Elements | Illusion Strategy | 12-Senses | Illusion Solution |
|---|---|---|---|---|---|---|---|---|
| [51] (Wang, 2014) | Sustainable building design | Structural engineering context | To achieve intelligent structure technology | Use hybrid and semi-active vibration controller | Balance | **(Living space)** | Balance | Flexible structure to adapt to household activities |
| [52] (Bangwal, 2022) | Healthy Workplace | Reduce exposure to viruses | Building can be fighting against the epidemic | Employee performance has levelled up because they adapt to building design | Growth | **(Outside/In)** | Vision color | Bringing natural elements into the building's interior |
| [53] (Bulbaai, 2021) | Energy-efficient building design | Building on tropical climate | Evaluate applying the passive building system | Creating outdoor and transition spaces such as balconies | Shape | **(Outside/In)** | Touch | Building transition outdoor area in each corner of the building |
| [54] (Dash, 2018) | Sustainable design, energy efficient | Biomimicry on building design | Gain more efficient energy usage | Get renewal design of the future building | Space | **(Repose and Silence)** | Vision color | Building shapes that support natural energy can save in building |

In addition to previous findings, the environment is impacted by architectural design and material [55]–[58]. The environment ensures architectural design comfort and combines elements, strategy illusion and 12 senses. Illusion architecture can be the solution for the environment in terms of architectural design. This method uses significantly more environmentally friendly techniques to tackle the architecture design problem than a standard solution. The overall result of the key uses illusions and cannot be seen in Fig. 8.

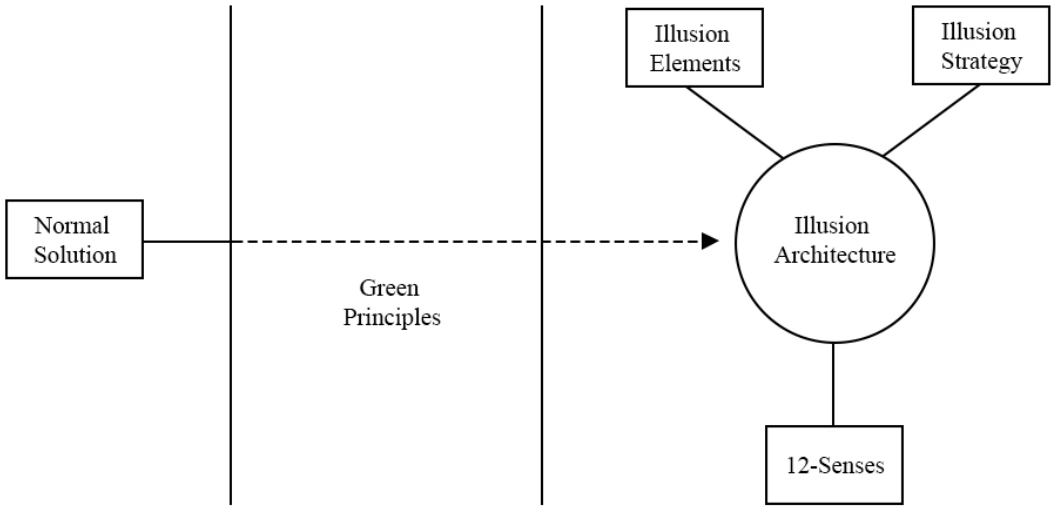


**Fig. 8.** Transformation framework from standard solution to illusion solution

The transformation from a standard solution to an illusory solution involves many things. Green principles and illusion architecture influence change into illusion solutions. The present illusion solution is influenced by element selection, illusion strategy, and 12 senses. The illusion solution is more effective in protecting the environment than the typical solution.

## Conclusion

As a result of environmental urgency in design architecture, the illusion has been attempted to address environmental issues in the present architectural design. However, getting the best results is challenging. This issue is solved by illusion in architectural design since this technique can trick the user into believing something untrue. The user no longer requires additional space as a result of this.

It significantly impacts environmental protection because it does not call for vast areas in an architectural design. The more untouched an environmental ecosystem, the better the environment. With the application of illusion in architectural design, it is hoped that it will bring about changes, especially in terms of a better environment, especially in the lack of land use, and also have a good impact on humans.

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