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# Illusion in Architecture: An Alternative for Creating Virtual Environment to Support Efficient Site Utilization

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ABSTRACT

Virtual materiality has become a reality due to technological advancements. This affects the evolution of architecture. Land utilization in residential designs is currently unrestricted. Humans still exploit natural land and food supplies to build homes. Conversely, houses that merely use the land for viewing rather than traversing it are an example of inefficient land usage. In architecture, virtual materiality plays a part in creating an artificial world. In order to minimize land consumption, an architectural strategy that may introduce virtual materiality into the real world is required. Illusion is one tactic. Tricks and deceit are given priority in the illusion technique. This program is intended for home users who want to replace their natural surroundings with an artificial one. By using this method, nature can improve without requiring interference from the original environment. Modeling experiments and qualitative research are used in the research methodology. Create suggested concepts by using an architectural methodology. Rendering models and sketches are the research outputs. The findings demonstrate that home design can make use of illusion as a representation of virtual materiality. Through the application of matter illusion techniques, manufactured environments can be made to resemble natural ones. Implementing the material illusion in a trapezoidal home. Screen technology is used to do this. The center of the design is where screen technology is used to display environmental content. big horizontal and vertical sides are necessary. However, this can be a substitute for the natural environment for residents, especially in dwelling design.



## 1. Introduction

Virtual materiality is a material that comes from the virtual world. It is now present as information and direction with AR (Augmented Reality) technology [1]. Currently, architectural design is starting to apply virtual materiality to the real world. The application of virtual materiality is not limited to changing real object into virtual ones, but in the form of effects that arise when applying these materials with the help of virtual technology [2]. Applications in the form of elements, content, etc. Virtual materiality is brought into the real world through technology. Technology aims to make users feel immersive in the presence of virtual materiality [3]. It can combine with material, technology and digital with the aim of producing various material experiences [4]. The implementation of virtual materiality is now developing in video games. Social, cultural and material aspects are developed so players can feel more real [5].

This paper applies virtual materiality to the real world through sensory. Technology is needed to accommodate this. Illusion is an approach that can apply virtual materiality to the real world. Dwelling design has become an object because dwelling construction so rapidly overgrowing, land use is ineffective. Experiments were carried out to find the right dwelling arrangement to solve these problems, which could later be applied to dwelling design. Experiments in architectural modeling were carried out to determine modular systems, and systematic and manufacturing architecture. A model like this requires modeling experiments because it is related to 3-dimensional installation [6]. The novelty of this research is supported by analysis through Vosviewer which integrates illusions, architecture, technology and sensory. That be tested in a model experiment. This can be seen in Figure 1.

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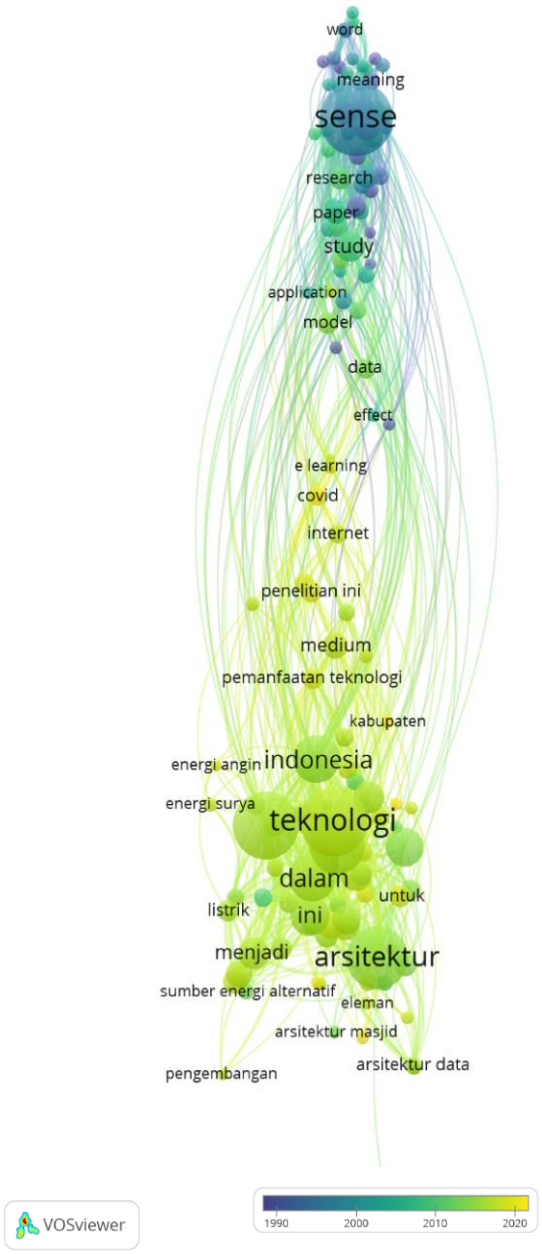



**Figure 1.** Analysis of research novelty through vosviewer

Analysis of the novelty of research via Vosviewer shows the novelty related to this research. Variable diagram formation related to illusion, technology and sensory. Vosviewer analysis shows that there is not much research related to illusions, technology and sensors. This is a novelty in presenting virtual materiality in the real world through illusion, technology and sensory approaches. The context of this research is dwelling. Dwelling is a residence that provides the user a sense of ownership and customization [7]. A residence has the property of being occupied for a long time. These residences are generally built on a piece of land.

The land space is used as a place for dwelling architecture. This causes a reduction in environmental ecosystem land.

Dwelling developments are now continuing to develop on the environment [8]. Over time, this can become a threat to living creatures, causing a natural imbalance that can have a negative impact on humans. A strategy is needed where housing can be built using minimal land. Illusion is magic aimed at an audience. Illusion in dwelling architecture is one application of virtual materiality in the real world. This illusion presents an artificial environment that can replace the original environment with a high level of similarity. This can happen because of sensory's role in manipulating the user's environment.

Matter strategy in Illusions in architecture is flatly changing 2 dimensions into 3 dimensions. The application of illusions to design gives users two perspectives comfortable and uncomfortable [9]. The application of illusions attracts the user's attention, one of which is the application in outdoor advertising [10]. Illusions can work in integration with technology, such as a visualization medium in planning that produces a hologram [11]. From similar research it can be concluded that illusions affect users and working with technology. This can be the basis for applying the illusion to a dwelling. The novelty of applying this illusion is that it uses technology and sensors in its application. The artificial environment can be presented as similar to the natural environment with the collaboration of technology and sensory systems. The application matter strategy of illusion can reduce land use.

In addition to implementing matter strategy in illusions in architecture which only focuses on visuals. This paper adds hearing and touch sensory as complements in responding to the presence of virtual materiality. Sensory is a stimulus or response medium that every human has. Generally, human sensory is divided into 5, namely sight, smell, hearing, taste and touch [12]. Humans will react to the sensory they receive. This reaction is the focus of the illusion. The illusion targets the sensory to be deceived by what it applies. The application of illusions to humans is applied to virtual reality. Sensory addresses users when they control an aircraft [13]. The application of illusions through VR (virtual reality) is to familiarize users with these activities. Even though they know this is just a simulation, the sensory experience they experience makes it difficult to differentiate between real and virtual.

The difference between this research and previous similar research is the aim and approach. This is different from research objective [14] which applies virtual as a learning

medium. Research [15] presents a virtual environment as a medium of interaction, exploratory in nature without expressing urgency. This research aims to minimize land use. The approach is also different from research [16] [17], namely using technology that is attached to the user. In this research the technology is physically separated from the user.

The aim of this research is to find a schematic concept for dwelling design that can minimize land use. Discovering a new type of illusion approach by combining technology and sensory. This schematic design concept can later be developed and applied to dwelling designs in order to maintain a balance environment by saving land use.

## 2. Methods

The method used is qualitative research [18] and experiment. Qualitative research was carried out to find similar theories and approaches that could support this research. Experiments were carried out in conducting studies on the application of illusions in dwelling architecture to minimize land use. The aspects to be studied relate to illusions, sensory, and technology that be applied to dwelling architecture in the context of minimizing land use. The research object is an experimental model. This research focuses on conducting trials to find the level of success in implementing research aspects. The theoretical framework can be seen in Figure 2.

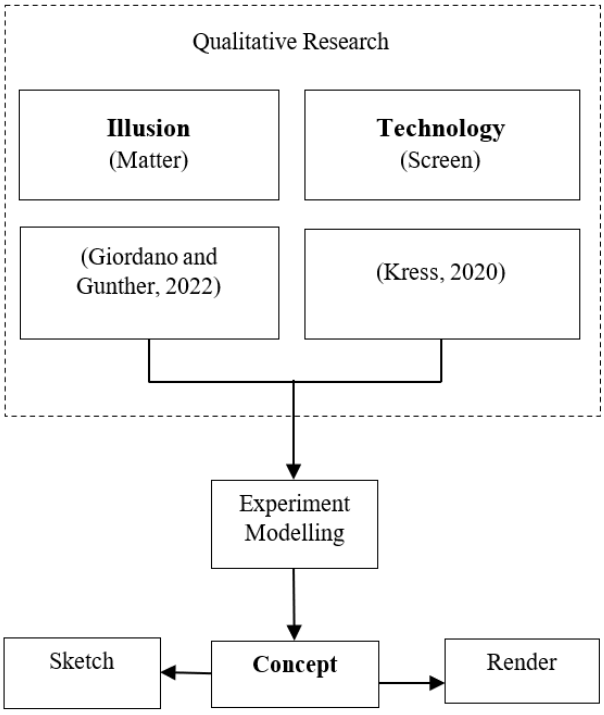



**Figure 2.** Concept research flow

This research discuss related to illusions [19] and technology [20]. The application is carried out on an experimental model that uses transparent material and a tablet as the screen. Analysis of the data is carried out experiments on a model. The experiment aims to ensure that the conclusions obtained are objective. This activity is an initial step before applying this approach is applied to dwelling architecture in the field.

The experimental method positions the appropriate material arrangement in the presence of a virtual environment. Materials have different levels of transparency. The preparation of this experiment uses screen technology that is similar in its application to dwelling design. Dimensions are determined according to the experimental scale. Virtual content on screen technology is special and can be modified. Details of the experimental materials can be seen in Figure 3.

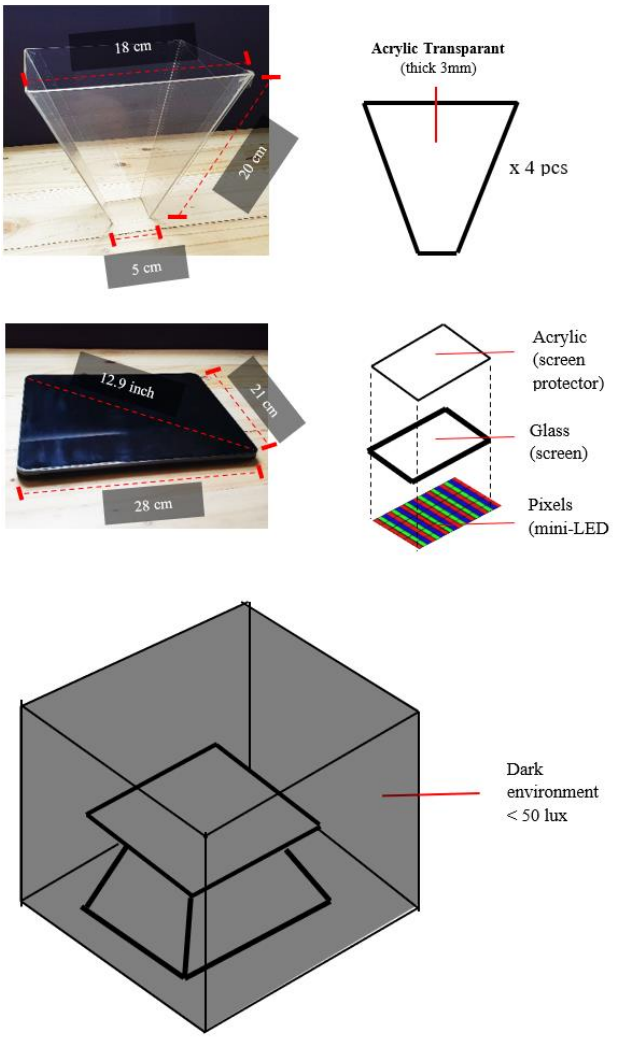



**Figure 3.** Details of the experimental materials

The materials used in the experimental method are acrylic and screen. Acrylic material arranged to form 4 sides is used as a support for the screen. The nature of the material is transparent. The screen used is a mini-LED pixel type. It is possible that other types of pixels can be used. The surrounding environment must be dark at least below 50 lux, so that the virtual content presented can be seen optimally.

## 3. Results and Discussion

This section will discuss virtual theory, illusion, dwelling, sensory, environment and technology. They are combining these things and applying them to dwelling design. Experimental modeling activities are carried out to test and explore before the design is implemented in the field.

### 3.1 Implementation of Virtual Materiality in Dwelling

Virtual materiality is a materiality caused by the presence of a virtual world [1]. The virtual world is a digital realm that can be accessed through certain platforms, one of which is the metaverse. One example of the presence of virtual materiality is by making objects feel real. We can interact with it through VR (Virtual Reality) media [21]. The application of virtual materiality aims to make things easier for humans, one of which can provide information, direction, etc. This can be seen in Figure 4.

While most studies reveal that the presence of virtual materiality is only a complement. Based on this research, virtual materiality is presented directly to give users an experience as if they were in a virtual world. Virtual materiality in the real world continues to develop and collaborate with other scientific disciplines, one of which is dwelling architecture. Virtual materiality makes dwelling architectural designs directly connected. In applying virtual materiality to the real world, a medium is needed, namely technology. Technology has an essential role in presenting virtual materiality, especially in dwelling design.

The presence of the virtual world hasn't changes to dwelling design. Unlike virtual material in general, which only displays content, the application of virtual materiality in dwelling architecture aims to create an artificial environment that resembles the natural one. This application is aimed at dwelling who use land excessively. By implementing an artificial environment, Users can feel as if they are in a natural environment. Applying this makes dwelling designs make effective use of land.

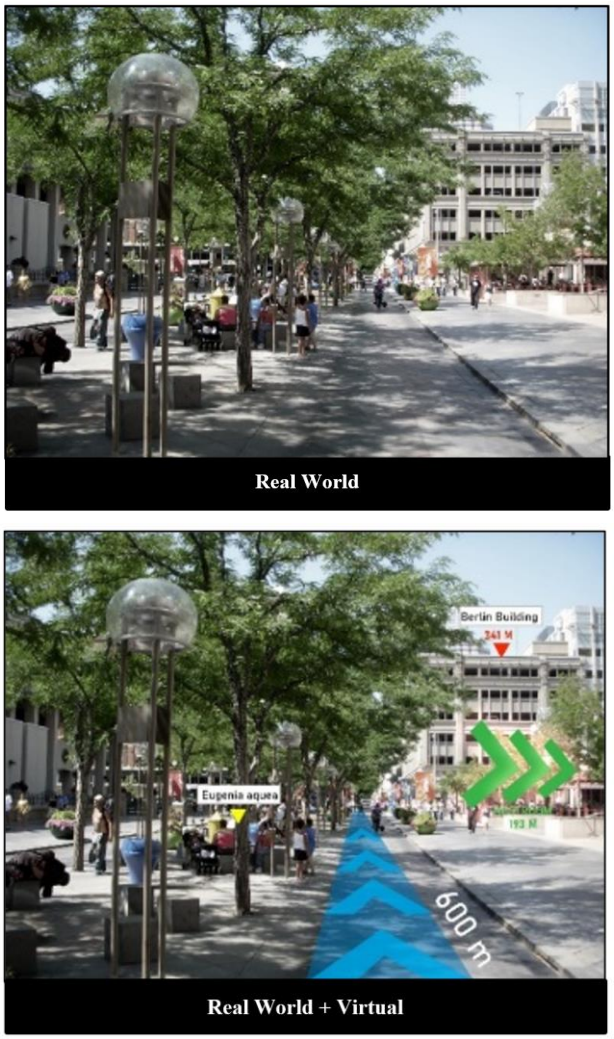



**Figure 4**. Implementation of virtual materiality in the real world

### 3.3 Technology Implementing Virtual Materiality

Technology has an essential role in the presence of virtual materiality in the real world. Currently technology continues to develop which ultimately makes humans live side by side with the virtual world. Currently, the application of virtual materiality in the real world has limitations, one of which is the application medium, namely smartphones, projectors, screens, etc. The application of this technology to architecture is limited to displaying content, but is not present in an integrated manner, especially in dwelling design. The division of technology for applying virtual materials can be seen in Figure 5.

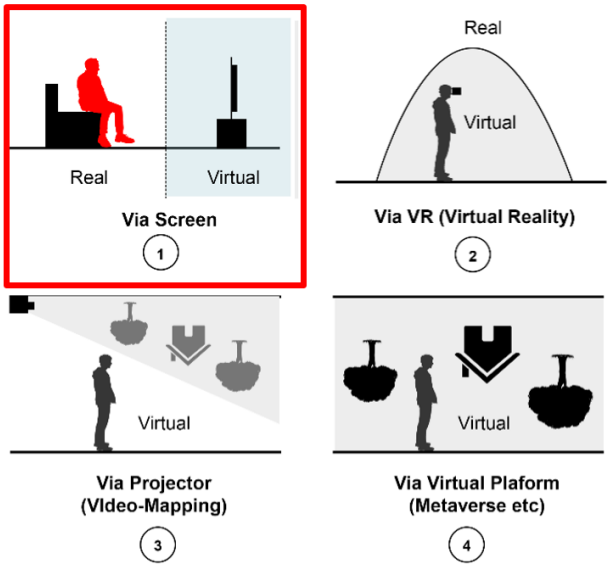



**Figure 5.** Technology for implementing virtual materiality

The development of virtual technology can form an artificial environment in museum design through VR (Virtual Reality) technology [22]. VR can treat impaired social functioning in psychosis [23]. The technology used to apply virtual materiality to dwelling design is in the form of a screen. However, the appropriate use of technology mostly attached to the user. In this research, the technology used is does not attach to the user to restrict movement. The use of screen technology is the answer. The screen displays content related to atmosphere, marketing, etc. This technology is able to change content flexibly. The arrangement of screens in dwelling design is essential.

The use of screen technology is separate from humans, unlike embedded VR. This allows people to feel freedom in their activities without being tied to certain technology. Technology that is physically attached to humans causes several problems. The advantages and disadvantages of this can be seen in Table 1.

Using a screen has many advantages. In addition to creating new emotions and has a low blue light effect. The disadvantage of using a screen is that it has a negative impact on mental health when viewed for too long; therefore, the screen is positioned above the user and the user cannot always see it directly. The placement of screen technology is also unlimited. It can be applied in any place and position with a supporting structure.

**Table 1.** Advantages and disadvantages of virtual technology

| Virtual Technology | Advantages | Disadvantages |
|---|---|---|
| Screen | - Creating new emotions [24]<br>- Low blue light emission [25] | - Mental negative effects when looking too long [26] |
| VR (Virtual Reality) | - Good for learning activities [27] | - Not suitable for everyone [28] |
| Projector (Video Mapping) | - Taking up the role of a cultural, traditional, and legend mediator [29] | - High level of user interaction [30] |
| Virtual Platform (Metaverse etc) | - Polish story and immersive visual effects [31] | - The price of display systems [32] |

### 3.4 Illusion in Architecture

Illusion is a method of performing magic tricks [33]. In conveying an illusion, appropriate methods, conditions audiences are needed. Magic elements are arranged which will explicitly presented to the audience later. Therefore, the point of view is essential in applying of illusion to magic. The use of illusion methods in magic shows must be following the target to be achieved. The illusion elements in magic have similarities to architectural elements. As time went by illusion was applied to architecture. Architecture now collaborates with illusion. Combining these things creates an illusion-based architectural approach [19].

Illusion architecture can be an approach to presenting virtual materiality in the real world. However, the implementation of illusion architecture not yet have many benefits to the environment. Therefore, in this research has benefit of being able to create an artificial environment that resembles the original environment. This results in reduced use of original land in dwelling architecture. Dwelling architecture through illusion architecture will provide users' needs in terms of feeling the quality of architectural space through sensory involvement. The division of illusion strategies can be seen in Figure 6.

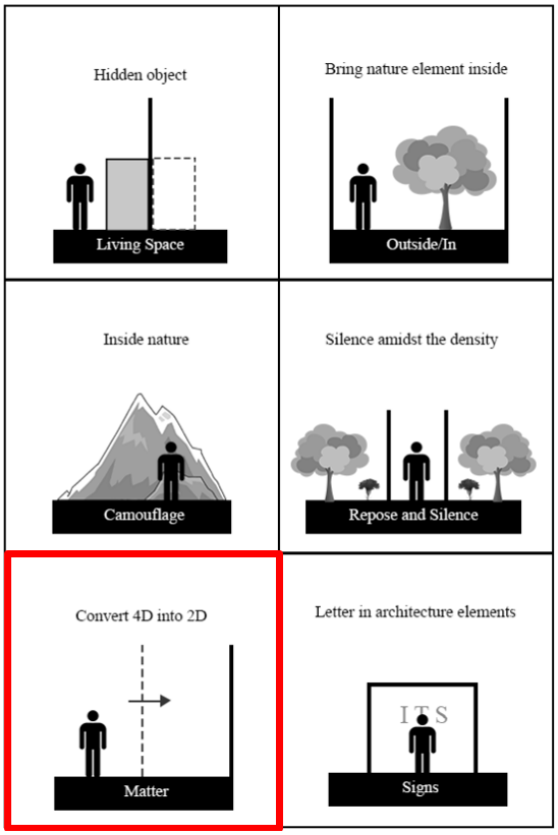



**Figure 6.** Illusion strategy in architecture

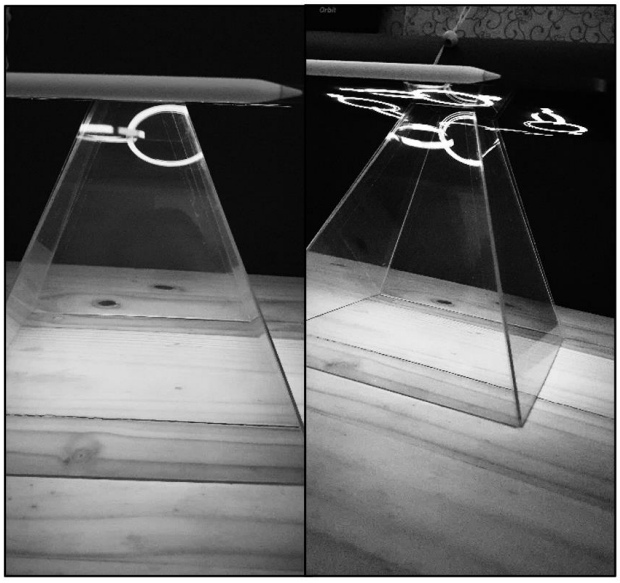


**Figure 7.** The illusion of creating an artificial environment

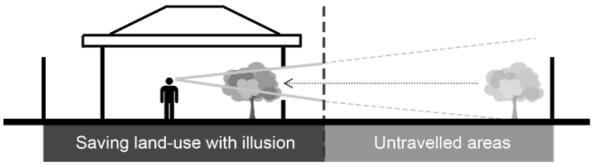



**Figure 8.** Material on land use efficiency

The illusion strategy in architecture has its own goals, one of which is environmental. Illusion architecture is an approach that influences human perspective when seeing and feeling it. This is an opportunity to design a dwelling on a narrow plot of land. One simple application of illusion is using a mirror. By using mirrors, the dimensions of a room will increase virtually. This will influence the user's perspective that the room has more area than it does. In this research, the artificial environment is produced through the diffusion of light through a transparent medium. This can be seen in Figure 7.

There are 6 illusion strategies, the matter strategy that applied above has the most significant impact on protecting the environment in terms of minimizing land use. This illusion strategy can turn 3D objects into 2D. In the context of land use, this strategy can make untraveled areas illusory. The first step in creating an artificial environment is through this strategy. Implementing this material strategy is supported through technology and sensors so that users feel real when they are in the dwelling design. This can be seen in Figure 8.

Users often use the land only as a visual, not for passing. This can make land use ineffective. However, the application of the illusion must be able to save on land use, namely matter. The matter illusion strategy can provide a visual experience as an artificial environment that does not require excess land. This application is supported by sensory input, making the artificial environment presented more realistic.

### 3.5 Environmental Urgency: Land Use

Unlike environmental protection strategies, this paper protects the environment through minimal land use. The environment has a natural ecosystem that must be maintained. One of the media where natural ecosystems occur is land. Protecting land is one step in maintaining natural balance. Architectural design must pay attention to environmental aspects, including land conservation [34]. Dwelling areas are generally built on land, and land use results in reduced ecosystem space for nature. Using minimal land can reduce the loss of natural ecosystems. In dwelling architectural designs based on land use, zoning is generally divided into two, land used physically and visibility. These differences can be seen in Figure 9.

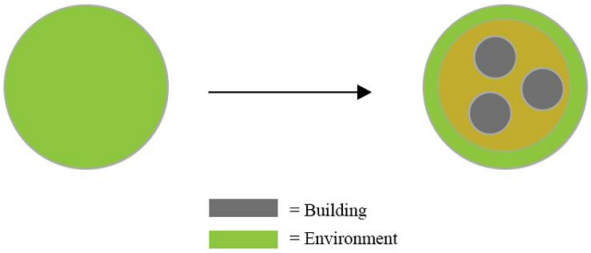



**Figure 9.** Land is used for dwelling construction

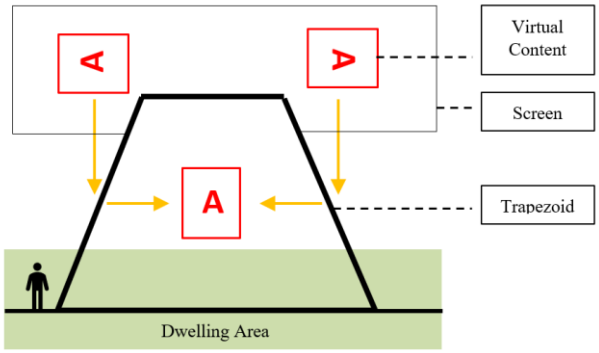



**Figure 10**. Exploration of forms that support the presence of virtual materiality using screen

The environment exists inherently according to its respective context [35]. Excessive use of land that is not physically used causes land use as a natural ecosystem to become less effective. However, based on the research above, land use according to context is not enough to maintain land use. It is needed development that occurs continuously means that dwelling must have an illusory architectural approach to preserve natural ecosystems. The application of an artificial environment through illusion becomes a substitute for the original environment in terms of visual use by the user. This similarity is enhanced through sensory in the dwelling's architectural design. This must be tested using modeling experiments related to programming, composition and appropriate form in dwelling architectural designs.

### 3.6 Method Validation: Experiment

This research will conduct experiments to determine the shape and position of dwelling designs that apply illusion, sensory and technology to the model. The experiment carried out 2 variables, control and independent [18]. Independent variables are shape and position. Control variables are holograms and virtual content. Shape and position influence the presence of holograms and virtual content in dwelling designs. This experiment will determine the best form and position for presenting holograms and virtual content to minimize land use in dwellings.

### 3.7 Experiment: Modeling Illusion Architecture in Dwelling

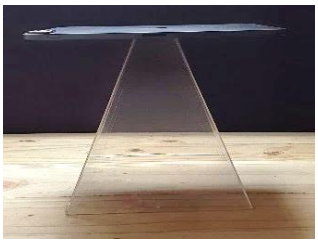
Different from the Al-Muka'ab design concept in Saudi Arabia [36]. Screens are not the primary source in providing an artificial environment. The artificial environment presented in this proposed concept is a hologram reflected by a screen. This modeling experiment explores appropriate programming, composition and form in presenting the illusion of dwelling architectural design. This experiment is a prototype of a dwelling design which can later be implemented in the field. In this model experiment, we explore forms that can support the presence of an artificial environment. Forms in the context of dwellings that fulfill basic dwelling needs. This form presents virtual materiality through screen technology (Figure 10).

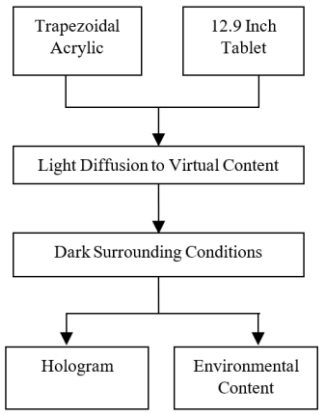
Different from making holograms using screen technology which is below, the dwelling design concept in this paper carries the position of the screen above. This is because the lower area is a circulation area for residential users. The trapezoidal shape was chosen because it can transmit light to one point. This form has a position above the screen where the screen is the medium for displaying virtual content. Users can see the results of transmitting light into one point in the form of a hologram. The viewing angle is outside the trapezoid. Therefore, in the design implementation the dwelling mass is positioned around the trapezoid.

This modeling prototype is experimental in the presence of illusions and sensors. Modeling experiments were carried out using simple materials that were easy to find. Modeling experiments are divided into tools, materials, programming, composition, position, illusion: hologram, illusion: environmental content, and parameter inference. The modeling experiment process can be seen in Table 2.

The experimental model shows that illusions in dwelling architecture can be implemented by applying technology to produce artificial environments through holograms and screens. This experimental model is a spatial element from a dwelling architectural design. This experimental model shows that technology can combine with architecture to produce an illusion. An illusion that can create an artificial environment. Illusion to housing can be applied by programming, composition and form in this experimental model. A sketch and render of the concept of application to dwelling architectural design can be seen in Figure 11.

**Table 2.** Modeling experiment

| Information | Pictures | |
|---|---|---|
| Tools and materials |  | This material is made of acrylic with trapezoidal form. The use of this material can unite the light bias in one direction to form a hologram. |
| |  | Screen Tablet is a technology capable of displaying holographic and environmental content. |
| Programming, Composition and Position |  | The tablet is on an acrylic trapezoidal screen facing downwards |
| |  | The perspective view makes the mass have a large roof covering the entire trapezoidal acrylic |
| |  | At an angle, the screen technology looks thin |
| Illusion: Hologram |  | The hologram does not appear to appear through the screen technology at this point of view. |

| Information | Pictures | |
|---|---|---|
| |  | Virtual content can be displayed differently according to the environment in which it is presented. |
| |  | Holograms are formed due to the reflection of content by the screen onto the acrylic trapezoid |
| Illusion: Environmental Content |  | Apart from holograms, the screen can also display environmental content, one of which is the sky |
| Parameter Conclusion |  | Presenting a virtual environment can be through holograms and content via screen technology. The conditions needed are a trapezoidal shape and surrounding conditions that tend to be dark. |

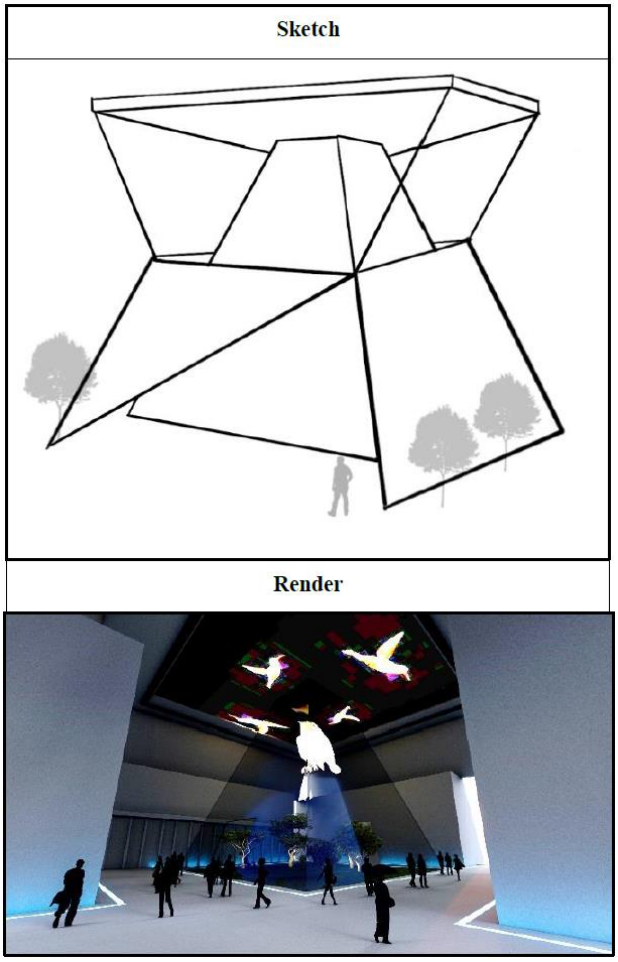



**Figure 11.** Modeling experiment concept

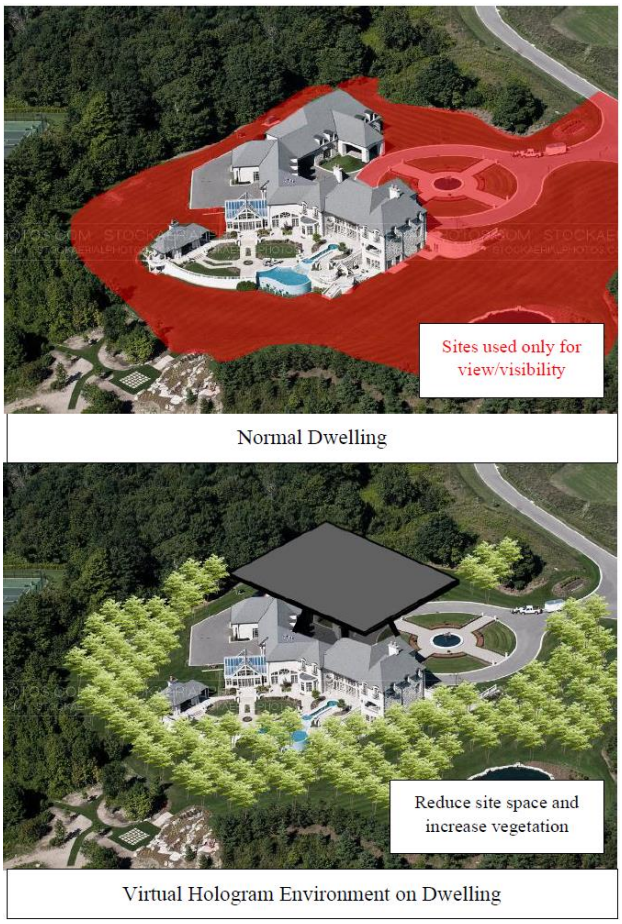



**Figure 12.** Minimizing land use in dwelling

The experimental model prototype will be a reference for field application. The concept sketch of a residence with an illusion approach uses two main masses, a transparent trapezoid as an object to diffuse light and a screen as a source of content display. The masses are arranged horizontally because the screen must display content directly towards the transparent trapezoid. The mass of dwelling is located around a transparent trapezoid when applied in the field. This is so that users can see the hologram formed inside. Applying this illusion will make the dwelling masses have the same view. This means that land use that is only a view can be replaced through an artificial environment via holograms. Through this implementation, land use can be minimized. The transformation from an ordinary dwelling to a dwelling applying an artificial environment through illusion can be seen in the Figure 12.

Dwelling designs generally have land that is used as a view. This land is used as a view even though users do not traverse it do not traverse it. This inefficient land use has a negative impact on the environmental ecosystem. Ineffective land use can later cause problems for humans. By using an artificial environment, the illusion can replace land that was only used as a view into an artificial environment using screen technology through flexible virtual content. This makes the arrangement of dwellings more centralized and does not require good site view conditions, one example of which is dwellings in dense urban areas.

The dwelling that protects the environment in terms of land use can be overcome through the application of illusion, sensory and technology. Combining the three produces a design concept in shape and position. The trapezoidal transparent mass is positioned between the dwelling and the screen above it. This can provide an artificial environment and is added with the application of 3 sensors, visual, auditory and touch.

## 4. Conclusions and Suggestions

This research concludes that the application of illusion to a dwelling can be applied. The trapezoidal mass is positioned in the middle of the residence so that all areas receive virtual environmental content. However, the large

crowd using screens raises doubts in the energy sector. Displaying virtual screen content uses a lot of energy. If you use non-renewable energy, this will cause new problems.

Future work could create renewable energy, such as developing solar panels capable of running screens non-stop. This energy is used by the screen to display virtual environment content.

## 5. Acknowledgment

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