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HALLUCINATIVE PERCEPTION IN ARCHITECTURE AND EFFECTS OF HOLOGRAPHIC PLATFORM ON DESIGN PROCESS

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Abstract
The hologram is a hallucinative image that produced virtually in yellow spot (macula lutea) and embedded in the physical environment with the help of photons. The hardware that creates hallucinative image is a portable head mounted holographic platform computer. The holographic platform computer senses the physical environment with the help of integrated cameras, sensors and lenses on it. The computer processes the information of the physical environment and integrates the information of the virtual environment into the physical environment and presents a holographic image to the user. In this way, it is possible to perceive the virtual environment which embedded in the physical environment and interact with the virtual environment.

Space perception is an important influence on designing and taking the final decisions in the architectural design process. In this work, firstly, the design ideas are expressed as sketches and technical drawings in the 2D digital platform. Secondly, 2D technical drawings transformed into 3D virtual models with the help of solid modelling programs. The virtual models have information about the physical environment such as light, color and texture. In this way, physical environment data is visualized in the virtual environment. Finally, produced models were modified, changes were made to the form and materials in the virtual environment to maximize the reality of virtual model. In this context, it is aimed to research the effects of the holographic platform on the architectural design process.

It is possible for designers, physically located in different locations, to co-exist virtually at the holographic platform at the same time and make modifications on the design. It is also possible for people in different disciplines who take part in the architectural design process to come together at the holographic platform to exchange ideas, design and work together at the same time. It is possible to produce solutions by interfering with the problems that may arise during and after the design process.

By using the holographic platform as a method in the architectural design process, it is possible to experience the ideas on the physical scale which have a direct effect on the perception. It is possible to experience the idea of architectural design at 1/1 scale when it is still in design process and to be able to reshape the design according to the ideas of experienced individual. By this means, the necessary modifications can be recognized and can be made at the design process. With using of the holographic platform in the architectural design process, the physical conditions have not been an obstacle to the cooperative work, high amount of profits has been gained economically and the time required to take final decisions of the design has been minimized.
Key Words: *Design process, hallucinative, hologram, physical environment, virtual environment*

1. Introduction

The basis of the architectural design process is recognizing what is available now and producing new by inspiring from the past and present. It is necessary to understand the concepts of plane, dimension and space to understand what is available now.

Visualization is the process of transforming a spatial object in design process, construction and post construction into two or three dimensional models by using symbols, simulations and animations that can be perceived by the human mind [1]. Visualization includes perception, communication, presentation techniques, analysis and applications related to the form interpreted by the techniques of expression [2]. Visualization is needed to perceive plane, dimension and space. Visual information is needed for visualization. In cases where visual information can‘t be accessed directly, written or verbal information can be used.

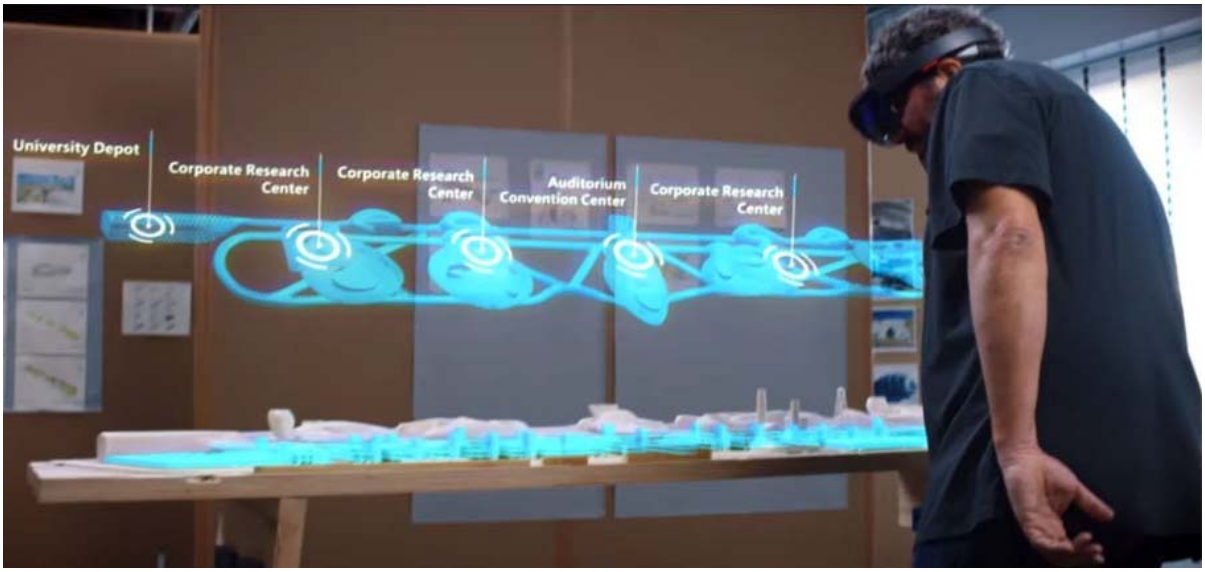

Fig. 1. Holograms [3]

Visual information can be created by examining written or verbal information. Visual information provides understanding of the space perception and the information about the space becomes meaningful. Different methods have been developed to create visual information and present it to the user's perception. Today, the most recent of these methods is the holographic presentation technique.

The hologram is a hallucinative image that produced virtually in macula lutea (yellow spot) and embedded in the physical environment with the help of photons. Holograms are produced in a holographic platform. The individual can perceive the virtual environment without being abstracted from the physical environment with the help of holograms (Fig. 1). The hardware that creates hallucinative image is a portable head mounted holographic platform computer.

Holographic platform computer (Fig. 2) has four sensors which scans the physical environment, one depth camera, one high definition video camera, and one inertial measurement sensor, one ambient light sensor which senses the physical environment light to calculate hologram brightness, four microphone and two optic see through holographic lenses [4]. The holographic platform computer perceives the physical environment data and transfers it to the internal processor which transform perceived data into digital information with the help of cameras and sensors.

The computer processes the information of physical environment and integrates the information of virtual environment into the physical environment and presents a holographic image to the user. In this way, it is possible to perceive the virtual environment which embedded in physical environment and interact with virtual environment.

Fig. 2. (a) holographic platform computer; (b) optic see through lenses; (c) sensors [5]

2. Perception in Architectural Design Process

Space perception is an important influence on designing and taking the final decisions in the architectural design process. Perception in architectural design process means the review of architectural design expressions in the designer's mind. Design ideas become meaningful and design ideas can be revised. Therefore, after the first decisions of the design are taken and the design is shaped, the design can be re-examined and necessary changes can be made. By expressing architectural ideas in the digital environment, it is possible to make the necessary changes without waste of time. Thus, we can evaluate the widespread use of computers as a representation tool of architectural product drawings and digital thinking can be evaluated as an affective way of designing and producing the architectural design process [6]. In this work, firstly, the design ideas are expressed as sketches and technical drawings in the 2D digital platform (Fig. 3).

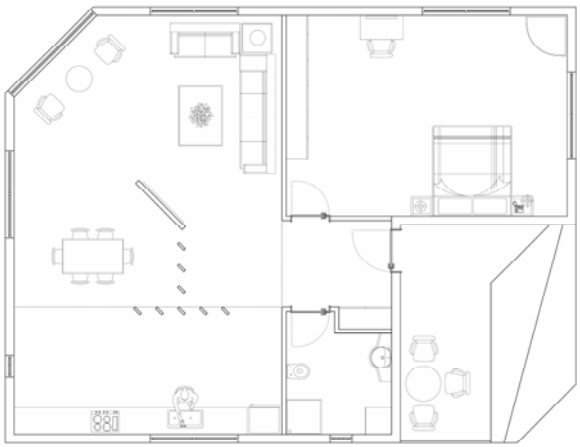

Fig. 3. 2D design

Expression of ideas in a two-dimensional environment was performed in two-dimensional vector drawing programs. With the help of these programs, ideas are transferred into the two dimensional digital platform. There are advantages and disadvantages of two-dimensional digital media because drawings can be viewed from a screen and the scale can be changed very quickly. It is the most important advantage that the entire architectural design can be seen as a whole. However, due to the rapid change of scale, perceptual distortions in the meanings of architectural proportions and dimensions can be observed. The designs expressed in two dimensions can only be perceived by individuals and designers who have knowledge in the field of architecture. For this reason, it is appropriate to add a third dimension to the two-dimensional drawings so that the design can be perceived more accurately. Secondly, 2D technical drawings transformed into 3D virtual models with the help of solid modelling programs (Fig. 4).

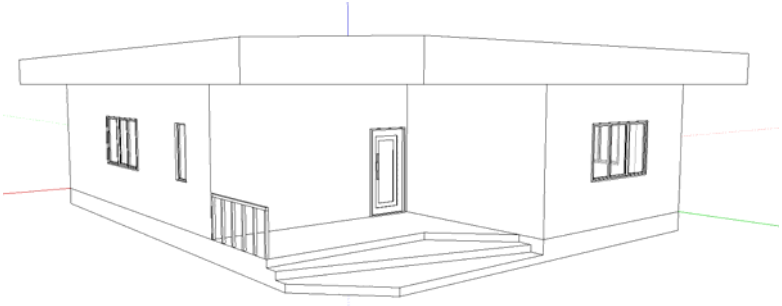

Fig. 4. 3D design

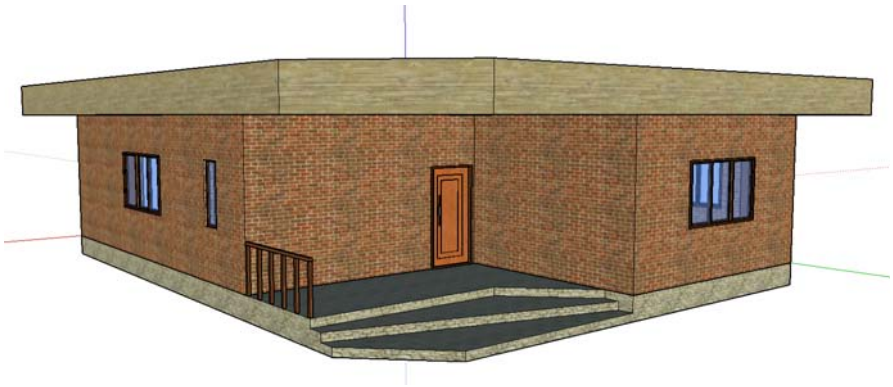

Fig. 5. 3D design with textures

While three-dimensional technical drawings were made, two-dimensional drawings used as a base and these drawings become boundaries in the second dimension of the design. Linearly expressed architectural elements are gained volume with the addition of the third dimension and become a simulation of architectural forms in the physical environment. According to the physical environment, color, texture and material coatings have been added to the architectural elements which become the solid model form (Fig. 5). Light source has been added to the architectural model to simulate physical environment lighting and shadows. Daylight tool was used as a source of light to simulate the sun rays. This tool provides the closest visual values to the physical atmosphere.

Thus, the virtual models have information about the physical environment such as light, color and texture. In this way, physical environment data is visualized in the virtual environment. After the third dimension is added to the digital design, it is possible to change scale so that the whole model can be perceived. However, even if the scale is changed, the degradation of the design that evaluated volumetrically is minimized. Thus, the individual and the designer can accurately perceive the architectural model. The connection between three dimensional solid model and the holographic platform was made by using a game engine (Fig. 6). Although game engines are not generally used in architecture, in this context they became a bridge between architectural design and holographic platform. The solid model, which was transferred into the game engine and contains the physical environment data, is transferred to the holographic platform computer.

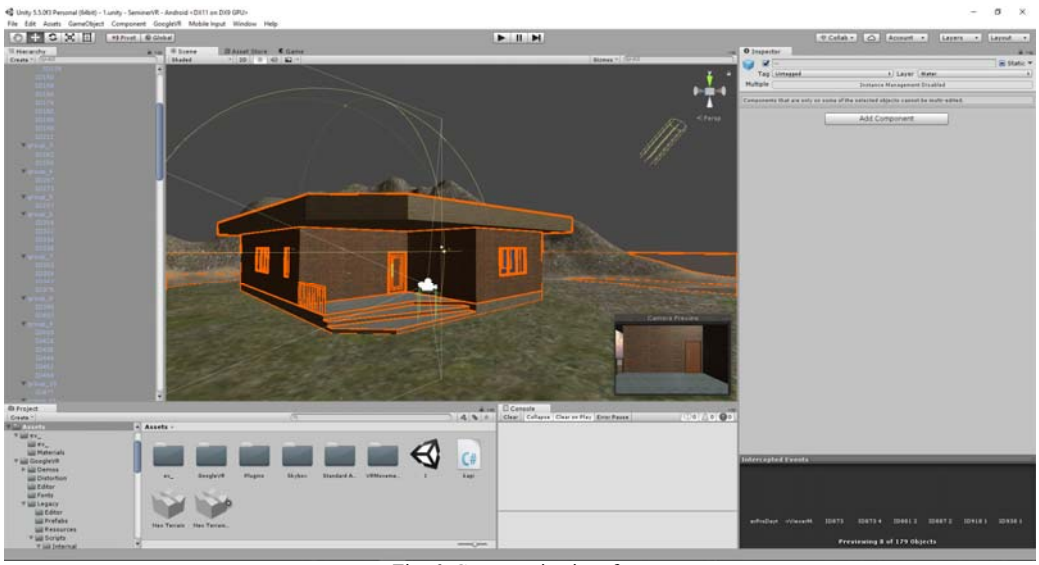

Fig. 6. Game engine interface

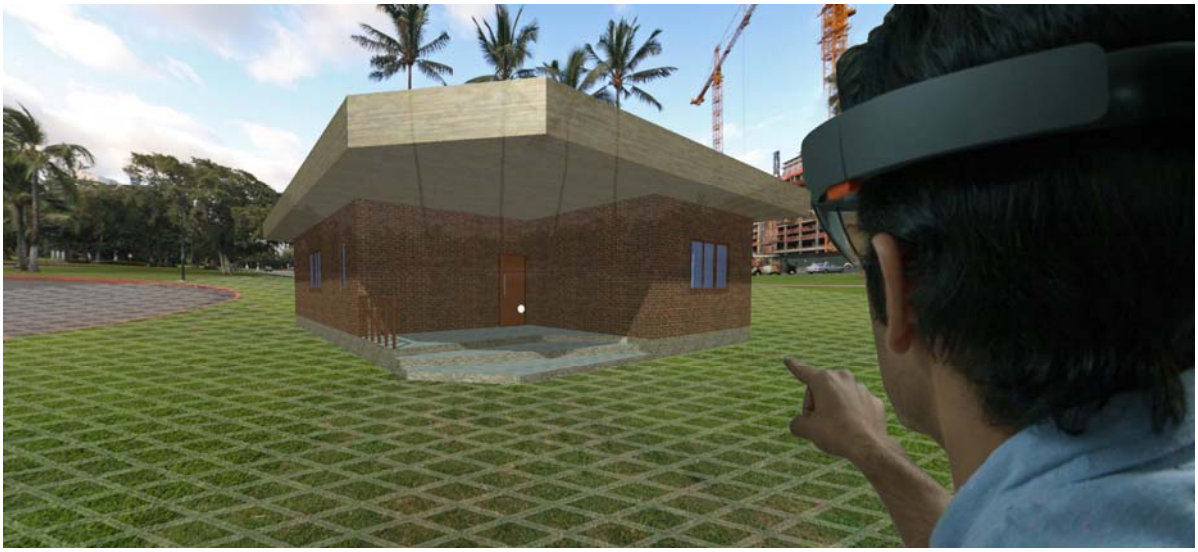

Fig. 7. Experiencing the design

The architectural model that created in the virtual environment have been experienced in the physical environment with the help of the holographic platform computer (Fig. 7).

Finally, produced models were modified, changes were made to the form and materials in the virtual environment to maximize the reality of virtual model. In this context, it is aimed to research the effects of the holographic platform on the architectural design process.

3. Collaborative Work

Cooperative design refers to a process that includes identifying common design goals, exploring solution possibilities, identifying constraints and developing solution proposals [7]. In this process, designers work collaboratively and communicate constantly. This process requires individuals to contribute to the sharing of information, to organize the division of labor and to regulate the resources so that everyone can reach resources [8]. It is possible for designers, physically located in different locations, to coexist virtually at the holographic platform at the same time and make modifications on the design.

Through the internet connection of the holographic platform computer, more than one designer can coexist in the same virtual environment at the same time. Using the internet connection, the holographic platform computer can virtually integrate other designers into the physical environment. Users who are integrated into the physical environment as guests can view with the help of avatars or can participate in a video conference with the help of a virtual screen (Fig. 8). Thus, the common working place can be either a virtual environment or physical environment. So the design can be produced quickly with the collaboration of different designers.

Fig. 8. (a) the avatar view; (b) the virtual screen view [9]

Fig. 9. (a) Construction; (b) design office [10]

It is also possible for people in different disciplines who take a part in the architectural design process to come together at the holographic platform to exchange ideas, design and work together at the same time. It is possible to observe the carrier system integrated into the construction. So the architect and the construction engineer who designs the carrier system can compare design ideas, observe and choose design solutions virtually in the design at the same time (Fig. 9). It is also possible to observe the mechanical project and the electricity project integrated into the static project or construction. In this way designs of all systems can be compared and understood. It is possible to produce solutions by interfering with the problems that may arise during and after the design process.

4. Experiencing the Design

In the architectural design process, perceiving and studying design at different scales is an important factor that affects success. In the traditional design process, designs were made with the help of sketches and physical models in different scales. However, it is not possible to express all the details on the physical models. For this reason, many details can be experienced during construction. Transferring the changes in design to the physical model causes designer to lose time and extends the architectural design process. Although, the important details of architectural ideas are only presented to the individual by making physical models with traditional methods, it is not possible to experience the design in different scales, especially on the real physical scale.

The changes in the design have quickly experienced by individuals with the help of computers. However, perceiving design from a screen is insufficient to experience of the entire design at the physical scale.

In the modern architectural design process, it is possible to experience the design ideas on the real physical scale with use of the holographic platform which directly effects the perception (Fig. 10). It is possible to experience the idea of architectural design at 1/1 scale when it is still in design process and it is possible to reshape the design according to the ideas of experienced individual. Experiencing the design at 1/1 scale has made it easier to understand proportions, sizes and architectural characteristics.

Fig. 10. (a) outside of the design; (b) entrance of the design; (c) inside of the design

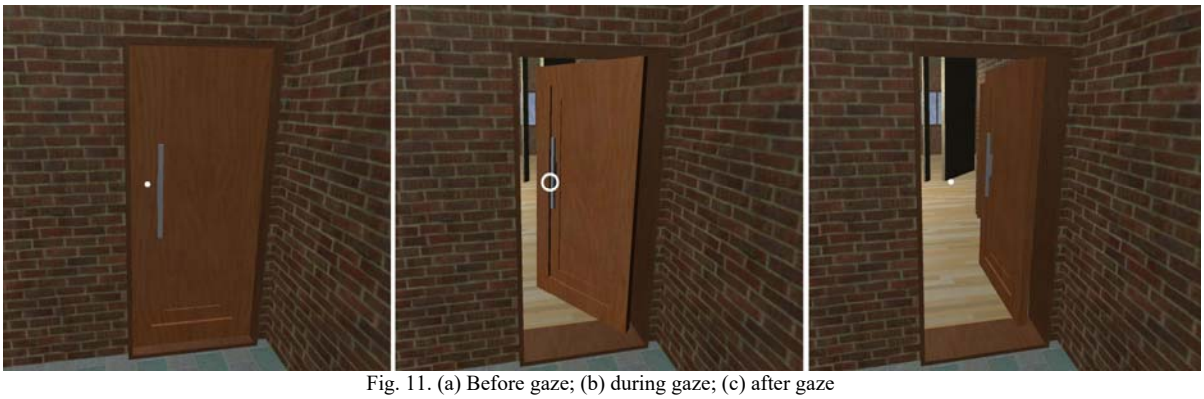

Fig. 11. (a) Before gaze; (b) during gaze; (c) after gaze

It is also possible to perceive the design and experience as if the architectural idea was already constructed in physical environment while in the design process. During the design experience, the individual or the designer is not a passive observer. Interaction with the virtual environment can be experienced as in the physical environment while experiencing design.

Interaction can be with a door that opens with the individual's movement, or it can be a change in the design. On the holographic platform, the interaction of the individual with the virtual environment can be made by voice, gesture and gaze input. Individuals can interact with the virtual environment using with voice commands.

The holographic platform computer recognizes the individual's voice with the help of built-in microphones and transforms the sound to digital information with the help of processors. After that, processors perform the desired interaction in the virtual environment. The individual can interact with the virtual environment by using gesture commands. The holographic platform computer detects the hand movements of the individual with the built-in motion sensor cameras. These hand movements are already defined in the holographic platform computer. For this reason, the command operations of the hand movements are performed. The individual can interact with the virtual environment by using gaze input. Individual activates or deactivates the commands defined on objects by looking at them in the virtual environment. For example, when the gaze input method is used to enter a place, the door opening command is activated by looking at the door and the door opens so individual can enter the place (Fig. 11).

5. Conclusion

The interaction between the design and the individual has created a new perspective in the architectural design process. It can be made with the holographic platform. It is possible to present detailed and high quality architectural ideas with the help of holographic platform. Thus, the individual can actively perceive the design. The link between the individual and the design has positively progressed with the help of interaction and the perception at 1/1 scale. Therefore, design ideas can be fully and correctly perceived by the individual. By this means, the necessary modifications can be recognized and can be made at the design process.

With using of the holographic platform in the architectural design process, the physical conditions have not been an obstacle to the cooperative work, high amount of profits have been gained economically and the time required to take the final decisions of the design has been minimized. Thus, the holographic platform creates a perceptible difference that effects in the architectural design process in the stages of design creation, experimentation, development and modification.

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