A JAVA PROGRAM MODEL FOR DESIGN-IDEA EXPLORATION IN THREE DIMENSIONS

Employed Visual Perception in Mass Exploration Process

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Abstract. *Visual Perception* of depictions is the basis of the act of imagining employed in visual design thinking of design process, and consequently in design-idea exploration. Digital-media use plays a significantly important role in these exploration processes. The underlying assumption of the research is that *Visual Perception* affects *Design-Idea Exploration* processes. The research investigates and sheds more light on the processes of *Visual Perception*, which architects use in mass exploration of design ideas. The research is a part of a series that presents a Java program based on creating 3d shapes, in order for architects to explore initial shapes related to design ideas. The initial version of the program, which is a part of another research, creates 3d shapes through controlling their dimensions and insertion point. Functions of painting, controlling the light position, and shading are added to the program that is presented in this research. The research discusses *Design-Idea Exploration* and *Visual Perception* and their correlation. The added features of the program that is used as a design medium are also presented and linked to the investigated areas.

1. Introduction

Architecture is classified as the high level of fine arts because of its functions, which are introduced to man besides aesthetics. Therefore, a design idea and its exploration process should be a goal-directed one resulted from main objectives of architectural design as creatively seen by the architect. Moreover, the methods of media use which architects employ have an important impact on the output of design process. This use, consequently, should be an assistance and addition to the role of architect, not a substitute

especially in the immaterial issues. This point of view represents the unfolding of the research and the presented program.

Exploration processes of design-ideas occur in our brains through visual design thinking. These exploration processes are inextricably linked to visual design thinking and the act of imagining, performed in architectural design process. The research investigates how visual perception process is developed in our minds, and then, introduces new functions of a Java program, which are used in mass exploration of architectural design-ideas, in order to apply the investigated areas.

2. Human Mind and Seeing

Human mind could be seen as a dual system of perception through the senses of sight and sound. Art is generally perceived through sound perception (literary art, music) or visual perception (architecture, sculpture, painting). The creation processes of images as forms of art in the human mind are beyond its natural level of perception and creativity. It could be stated that an artist or designer thinks more and sees more. The human mind encompasses different visual images as raw material. The difference between a common man, and a visual artist or a designer actually lies in the mental skill of the last case to employ this raw material for art creation or design.

To see is only to mirror the physical properties of an object as reflected in the mind. This simple notion is different from visual perception, as the last is more constructive. Psychologists, while studying visual perception, give evidence that the image is not given to the mind, but it is structured by our mind, through past images and several other subjective aspects, which differ from one to another (www.artinarch.com/vp12.html). The human eye, at any situation, does not act as a mere camera. An art critic and psychologist, Prof. Margaret Hagen states that “there is a traditional and philosophical distinction between sight (seeing) and knowledge. Seeing is experience of sensation, and knowledge is construction of meaningful perceptions” (Hagen, 1986). The final image in mind of visual artist or designer transforms into shape after constant confrontation with past experiences in process of imagination.

Furthermore, there are two basic things in perception; data and knowledge. The philosopher James J. Gibson advocated a theory that visual data passes from the retina to the mind where it is formed into perception of a meaningful whole (Gibson, 1994). Some other philosophers, like Richard L. Gregory, go beyond that and adopt a constructivist stand that the knowledge decides what we see, and what is understood as seen (Gregory, 1998).

From the previous discussion, it could be stated that both perceived past experiences, and conceived data and knowledge, have impact on the final image created in mind of visual artist or designer.

3. Gestalt Laws and Visual Perception

Famous philosopher and psychologist, Larry Day while commenting on paintings as paradigms states that one cannot view any image as if it is the first image (www.artinarch.com/vp12.html). The images approach us with a history that we made up of resemblances, borrowings, biases, personal inclusions and exclusions. These images are more cultural in nature than physiological. An art critic and psychologist, Professor Margaret Hagen states that the product of perception is constructed out of sensory raw material through process of trial and error, and testing of hypothesis, rather than a mere product of simulation (Hagen, 1986). The foregoing findings give evidence, which links between visual perception and Gestalt laws.

3.1. GESTALT LAWS

Grouping is the idea of Gestalt theory. According to Gestalt laws, we perceive forms as well-organized patterns or as a whole, rather than separate component parts. The main factors that determine grouping in visual perception are: proximity, similarity, closure, and simplicity. Elements tend to be grouped together depending on their closeness and according to symmetry, regularity, and smoothness (Ellis, 1939).

There are many concepts in terms of illustrating the Gestalt laws. Two of them, however, are basically related to the investigated area of the research; namely:

1) The concept of shape and background: while forming any (abstract or symbolic) visual image, a dominant shape of image is separated from the image background (Ellis, 1939).

2) Perception of objects is far more constant or stable than retinal images: For example, if we relied only on the retinal images for visual perception we would always be conscious of people growing physically bigger when they come closer. With the same token, colors change with every shift of lighting condition [Figure 1], and objects change their shapes whenever we moved. But, this does not usually happen. In summary, key consistencies in relation to visual perception are site, shape, lightness, and color.

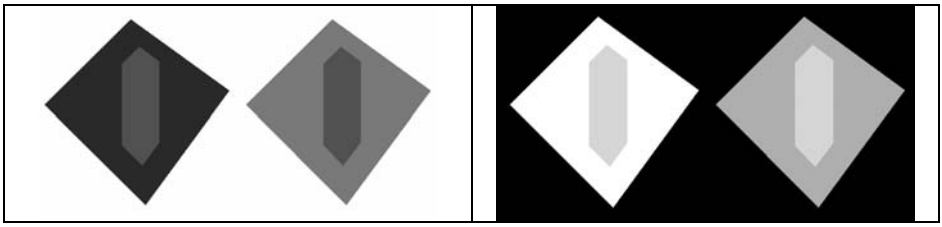


Figure 1. An example of the perceived brightness, which is influenced by the context and does not simply correspond to the physical intensity, prepared by the author.

3.2. VISUAL PERCEPTION AND DESIGN-IDEA EXPLORATION

It is hard (one may maintain impossible) to give and develop a design idea without the use of drawing or modelling. Designers shape, evaluate, and reshape their design ideas through drawing or modelling. In the early design process, designers use different kinds of depictions, through different methods of media use to explore, develop, and record ideas. While solving design problems, a diagram through visual design thinking is used to transform the data and documents of design program into a graphic context. “Diagrams are in the sketch books of famous designers such as Louis I. Kahn (Brownlee and Long 1991), Le Corbusier (Guiton 1987; Sekler and Curtis 1978), and Peter Eisenman (Eisenman 1987)” (Do and Gross, 2001).

The act of imagining is intimately bound with visual design thinking. Designers employ visual design thinking to visualize and understand the forms they work with.Visual perception of different representations has a crucial role in design thinking, imaging, and evaluating, which are used along with design process.

From the work of Schön that classifies the kinds of seeing and their functions, the structure of design is a cyclic combination of seeing-shaping-seeing (Schön and Wiggins, 1992). It, therefore, could be concluded that visual perception of design-idea exploration lies into three phases, namely: 1) factual visual apprehension of forms, 2) appreciative judgments of characteristic, and 3) comprehension of spatial gestalts.

The foregoing phases of visual perception occur during the interaction between mind of the designer or architect, and depictions (drawings and models). Consequently, visual perception processes are essential in the exploration of design ideas and proposed forms.

From the previous discussion, it could be concluded that the Gestalt laws related to visual perception are used through the act of imagining and

thinking. The main factors of these Gestalt laws are color, light position (shade, brightness), and position of seeing (shape or site).

4. Applying Visual-Perception Factors in the Java Program for Mass Exploration of Architectural Design Ideas

This part of the research applies the factors that govern the processes of visual perception employed during mass exploration of architectural-design ideas. The program, used as a design medium, helps architects create, manipulate, and explore three dimensional shapes related to architectural design-ideas. Architects, by using this program, would be able to easily control the camera position to explore their initial forms.

The famous 3d modeling software (AutoCAD, 3ds max, FormZ, Sketch-Up, etc.) apply the approach of transforming the created drawing, when the user changes the camera position. The unique difference of the program from these programs is the approach of transforming the camera position without the drawing, which allows the manipulation (of both the objects and the camera position) in the new created views. Transforming the created drawings in X, Y, Z, or all the three directions are available functions of the program.

4.1. PREVIOUS FEATURES OF THE PROGRAM

The main features of the previous program version are the functions of transforming the created form or forms, by mouse clicking inside the boundary of one form to rotate or move the chosen form, or by mouse clicking any point outside the forms to rotate or move the whole combination. The grid, also, can be solely transformed. The snap, grid limit, and grid view can be reset from the edit menu of the program.

The previous version of the program is based on creating 3d shapes, through controlling their dimensions and insertion point in two different ways; pull down menu, and mouse click and drag.

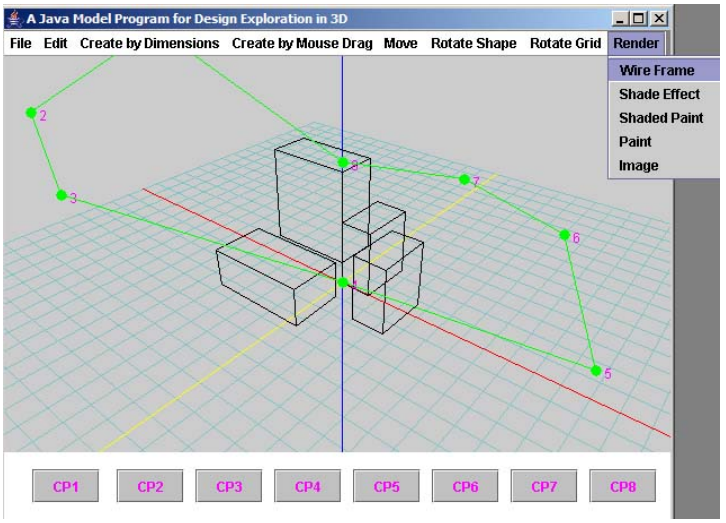
The program displays eight camera positions that are located around the created drawing, with the option of controlling each position in z direction through mouse drag [Figure 2]. The users of the program can explore a drawing through: changing the position of camera from the selected eight positions, or rotating the drawing in one direction or all the three directions.

4.2. ADDED FEATURES OF THE PROGRAM

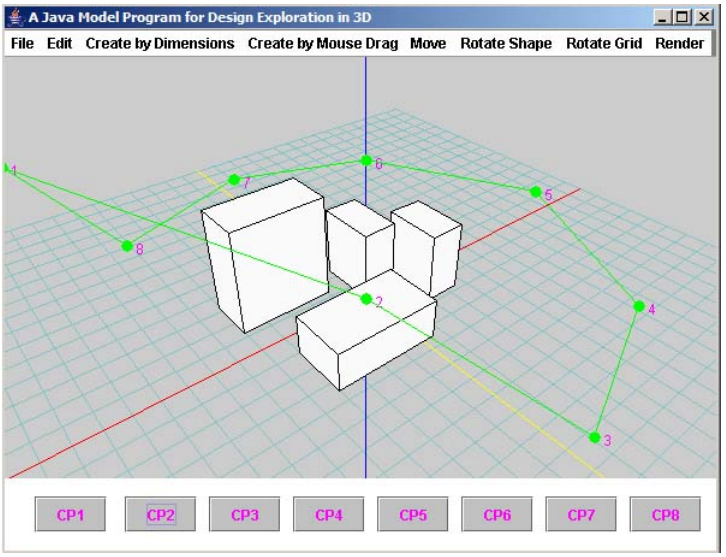
Functions of rendering, painting, controlling the light position, and shading, represent added features of the program, which have links to visual perception.

4.2.1. Render

Rendering functions encompass functions of wire frame and painting [Figure 2].



a- Wire frame drawing viewed from 4th camera at a higher position

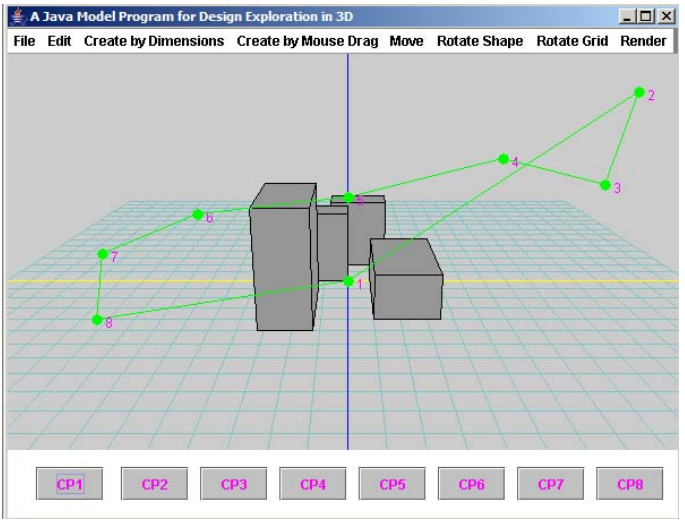


b- White painting drawing viewed from 2nd camera at a higher position

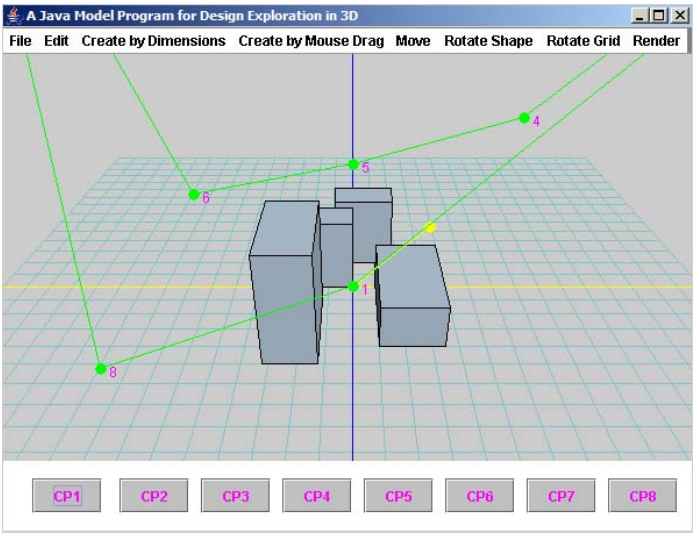
Figure 2. A four-mass combination of a design idea (the green circles represent the camera positions, the user can control each camera position in z direction by mouse drag).

4.2.2. Shade effect

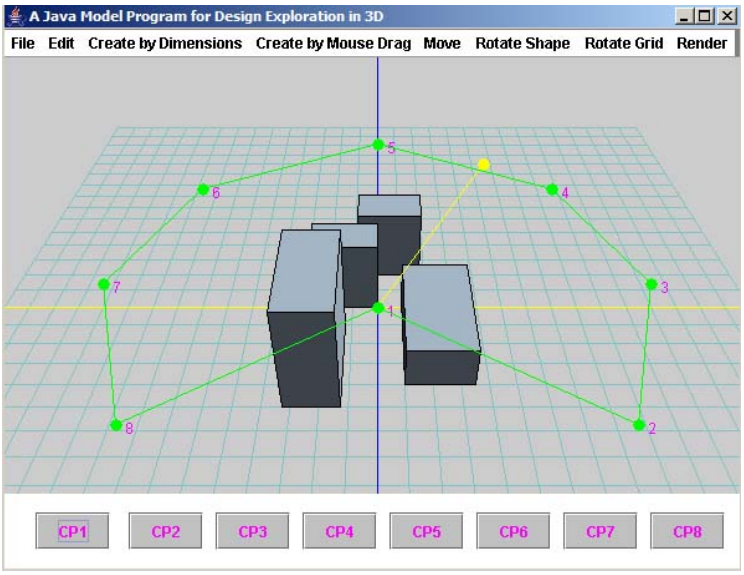
The program has functions of controlling the light position [Figure 3].



a- Grey painting drawing viewed from 1st camera of the default position without the shade effect



b- Light-blue painting drawing viewed from 1st camera at a higher position after adding the shade effect



c- Same drawing viewed form 1st camera at a higher position after changing the light position

Figure 3. Controlling the color of the whole combination, and the light position

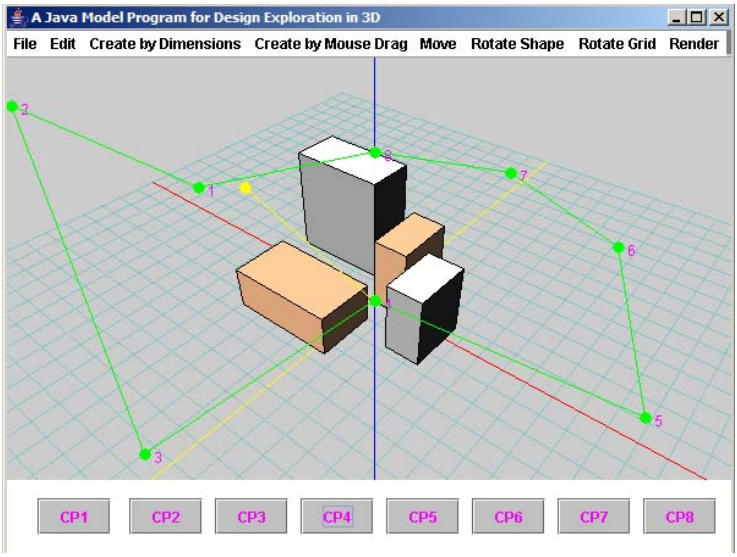
4.2.3. Shaded Painting

The program has a function of controlling the color of a form or the whole combination [Figure 4].

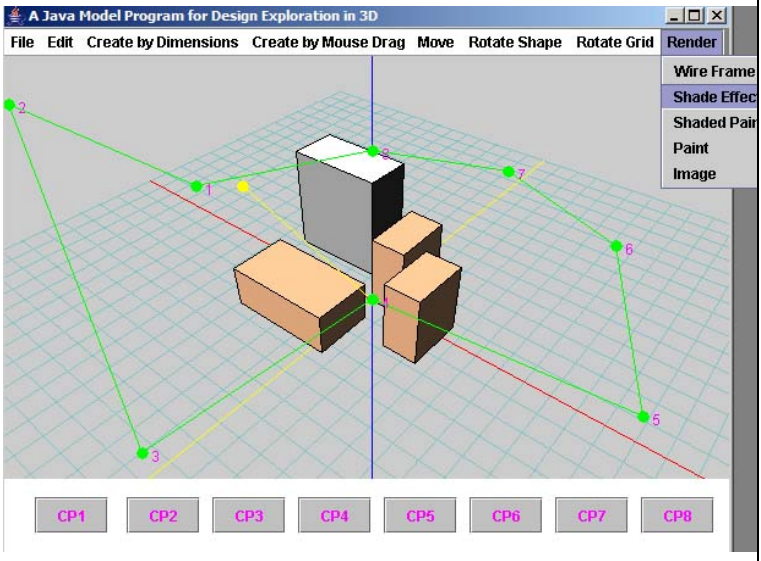
5. Conclusion

The research has highlighted the correlation between Visual Perception and Design-Idea Exploration. The main factors of visual perception processes, which are used through the act of imagining and visual design thinking in three dimensions, are color, light position (shade, brightness), and position of seeing (shape or site).

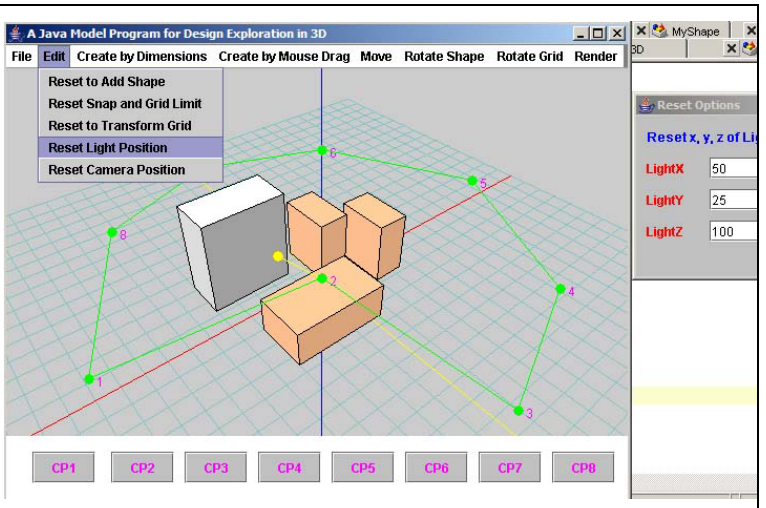
The research has applied the investigated previous factors in functions of the Java program model, which is used in mass exploration process. The presented program with its added functions can be applied in creating and exploring initial three dimensional shapes of design ideas.



a- Changing a color of two forms viewed from 4th camera at a higher position



b- Changing a color of one form viewed form from 4th camera at the previous position



c- Changing a color of one form viewed form from 2nd camera at a higher position, and the menu of controlling the light position

Figure 4. Controlling the color of form, and the menu of controlling the light position.

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