HUMAN PERCEPTION OF VISUALIZATION TOOLS USED FOR VISUAL IMPACT ASSESSMENT

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Abstract. This paper discusses the visualization tools and methods used to examine human perception in Visual Impact Assessment (VIA). One of the key conservation areas in Kuala Lumpur was selected in the study to measure the impact of different types of visualization tools. This paper recommends that human perception contributes towards the improvements of the visualization tools for VIA. The study found out that the common visualization tools used were not the most preferable tools among respondents. On the contrary most respondent preferred interactive visualization that offered more visual possibilities leading to a better understanding of landscape design. Apart from this, the study identified that the visual perception between the respondents who have different formal education background have similar concerns on the visualization tools tested to them.

1. Introduction

Visualization tool is one of the important components in Visual Impact Assessment (VIA) to establish the information between the assessors and assessment method. As Mahdjoubi and Wiltshire (2001) explained, the

visualization tools were used for communication, collaboration and decision-making in built environmental assessment. Unlike in the early days, the decision for VIA often relied much on highly abstract representations such as drawings, sketches and still photos that were targeted to give a better understanding of the landscape design which was less abstraction. Advanced digital forms of visualization tools were then incorporated to provide more dynamic representations in the static and dynamic forms such as still digital images, QuickTime VR (QTVR), animation, and interactive visualization.

While these visualization explorations contributed at certain greater heights Lange and Bishop (2005) highlighted the concerns on the perceptual and societal issues. According to them, it is crucial to study more on the human interaction perception of the visualization tools that highly influenced the results of the VIA assessments. Considering this, three important factors were identified on the level of interaction between the users and the visualization tools:

(1) What are the perceptions and level of interactions between the experts and general public between the static and dynamic visualization?
(2) Can the commonly used visualization tools be considered as the mostly preferable tools amongst the users?
(3) Which visualization tools can communicate well in term of contents on the visual environment?

One of the key conservation areas in Kuala Lumpur was selected in the study to measure the impact of different types of visualization tools in VIA namely digital stills, QuickTime VR (QTVR), animation and interactive visualization. The methodology was developed based on visual analysis research suggested by Lange and Bishop (2005), Bishop and Rohrmann (2003), Sanoff (1991), and Sheppard (1989). This paper recommends that human perception contributes towards the improvements of the visualization tools for VIA.

2. Visualization tool and issues

Visualization tool is a visual representation to assist the process in VIA as a means of communication between the decision makers and the methods used. McCormick defined visualization as a method of computing that transformed the symbolic into the geometric, enabling researchers to observe their simulations and computation (Bishop and Lange, 2005a). Visualization offers a method for seeing the unseen. It enriches the process of scientific discovery and fosters profound and unexpected insights. Computer applications for visual representation have become common tools for researchers and groups involved in VIA. Bishop and Rohrmann (2003)

mentioned that landscape, environmental and urban researchers have begun to adopt the new technology for the purpose of design communication, resource management and research into human responses to environments.

Visualization tools can be considered as one of the key factors that influence the results of VIA. These factors are divided into two domains that are related namely the technology and the user perception of the visualization tools. Mahdjoubi and Wiltshire (2001) mentioned that the visualization using computer technology has improved communication process as well as it has favorable public participation in the planning and design. They also explained that more research was needed to clarify the potential of visualization tools to arouse interest. Lange and Bishop (2005) highlighted the concern on the perceptual and societal issues. According to them, it is crucial to study more on the human interaction perception of the visualization tools that highly influenced the results of the VIA assessments. The issues of human perception of the static and dynamic visualization tool also needs to be considered as the advancement of the computer technology and other technology of course will change the way human interact with the technology. This issue was supported by the working theory (Gordon, 2004) where visual perception was a knowledge driven process where human may adapted any visual perception as the knowledge and skills were available to them.

2.1 VISUALIZATION TOOLS

The tested visualization tools ranged from the simplest to most complex tool. Four types of visualization tools were identified as followed:

(a) Still digital image: Still digital image is the alternative source for analogue photographs that exist in digital form. Nobuyuki (2005) clarified that there is no difference between analog and still digital image as their function to capture a momentary scene. Current technology nowadays suggests digital cameras for the ease of use with better output. As mentioned by Bergen et al. (1995) photographs (either slide or print pictures) are the typical media for representing landscapes in psychophysical studies, and have been found to be acceptable surrogates for the landscapes they represent.

(b) QuickTime VR (QTVR): QTVR is one of the examples of dynamic visualization. Images will be stitched together that enable users to zoom, pan, and tilt. Advanced image manipulations enable linking capabilities from one to another scene. Bishop and Lange (2005b) mentioned Quick Time VR (QTVR) format allows a full 360º panorama to be viewed on a normal computer monitor.

(c) Animation: Cited in Lange and Bishop (2005), Zube mentioned that animation of simulated landscapes for planning purposes did not begin with computer graphics. Instead, it started with analogue such as a 'modelscope' then continued with digital technology and later to the computer three-dimensional modeling. Sheppard (1989) explained that animation was a dynamic simulation in which objects were seen to move or the viewer moves through a three-dimensional scene. Animation can involve either movement of objects within scene, movement of the camera or both. In presentation of projects for public comment it is a common option to provide a fly-over or walk-through of a site to give a more complete picture of the environment being considered (Bishop & Lange, 2005b). Lim et al. (2006) mentioned that in landscape planning, three-dimensional images landscapes made by computer graphics have been mainly used to predict the impact of proposed plans of landscapes.

(d) Interactive visualization: Interactive visualization allows interaction in virtual environment. Users were able to interact within the virtual environment by using two sensory feedbacks as suggested by Sherman and Craig (Bishop & Lange, 2005a). They separated the 'interactive criteria' into two parts that they clustered as sensory feedback (body tracking) and interactivity (object manipulation). More importantly, they separate the virtual world (the collection of virtual objects and the rules which govern their behaviour) from the medium through which the virtual world was accessed. This separation of the world from the medium also permits a clear definition of a virtual environment as being a virtual world and an instance of a virtual world presented in an interactive medium such as virtual reality (Bishop & Lange, 2005a). An example is given by Tahrani et al. (2005) for research teams to evaluate the use of virtual reality as a potential decision making tool in cognitively evaluating urban day lighting ambiences.

4. Research Methods

This research was constructed based on visual analysis methods suggested by Sanoff (1991) and procedures (Bishop and Rohrmann, 2003). Bishop and Lange (2005) mentioned that one of the major variables in visualization was identified as the level of interaction available with data for cartographic purposes. Moving beyond the cartographic context, they have recognized important distinctions that can be made within the realm of visualization which include: (i) abstract versus realistic presentation, (ii) dynamic versus static views, (iii) single versus multiple displays, and (iv) immersive versus non-immersive display. As for this research, it only focused on dynamic versus static views in the realm of visualization. Whereas for the procedures, four components suggested by Bishop and Rohrmann (2003)

were implemented. These include the design of the data collection, development of the model of visual representation, the questionnaire and the data collection procedure.

4.1 THE DESIGN OF THE DATA COLLECTION

The design of the data collection was made based on the three main questions mentioned in the previous section. In order to address these questions, a survey was organized using selected respondents in a computer lab (control environment). The respondents were selected from different background as to study the differences and similarities exist in them which may help the research to understand further on human perception of the visualization tools. The respondents were the students of a public university representing 3rd and 4th year students of Landscape Architecture (designers) and Quantity Surveying (non-designers) course were asked to experience using four different visualization tools. Each respondent was provided with individual computer screen within 45 minutes to answer all questions.

4.2 DEVELOPMENT OF THE MODELS OF VISUAL REPRESENTATION

The development of the model of visual representation was based on Sheppard (1989) criteria mentioned by Mahdjoubi and Wiltshire (2001) that proposed five criteria to improve comprehension, credibility and bias-free visual simulation. These are:
(a) Representativeness: the degree to which simulations represents typical views of the project.
(b) Accuracy: the degree of similarity in appearance between the 'simulated' and the 'real' scene.
(c) Visual clarity: the degree to which detail, parts, and overall content of the simulation can be easily understood and recognized.
(d) Interest: the degree to which simulations hold the interest of the audience.
(e) Legitimacy: the extent to which the correctness of the simulation can be demonstrated and justified.
The samples of visual representations developed for this research are shown in Figure 1.

Figure 1. The samples of visual representation created using 3D Studio Max.

Four types of visualization tool suggested in this research were identified and carried out in the Kuala Lumpur conservation area. The representation used a model plane technique and mapping process of the existing street condition using still digital images established from the site.

4.3 THE QUESTIONNAIRE

The questionnaires were developed based on the visual analysis techniques mentioned by Sanoff (1991). The four types of survey were summarized as below:

(a) Perception choice survey: Perception choice survey was derived from the technique to best fit the slide concept. It identified the individual respondents' choices made from the visualization tools options. The choices by the respondents were made from certain category reflected the focus of the research framework.
(b) Appraisal survey: Appraisal survey was the technique to develop deeper understanding of visual environment in a self-guided tour. The respondents were given a set of questions that they need to give the score for each question based on the numerical score ranged from 1 to 7. This technique focused on the respondents' perception of different visualization tools in the targeted area.
(c) Content survey: A technique used to test the respondent's awareness of the visualization tools. This technique suggested the adjective rating scale primarily to rate the contents and the visualization tools.
(d) Functional survey: This survey was developed to identify the frequency of usage and level of exposure of the visualization tools. It was intended to identify the understanding and familiarity of respondents on the tools.

4.4 THE DATA COLLECTION PROCEDURES

The data collection procedure was referred to Bishop and Rohrmann's (2003) studied on the psychological validity of assessment for environmental simulation. Six steps of the data collection were indentified and summarized as below:

(a) The respondents were gathered in a common computer lab and short general instruction was given to the respondents on the survey procedures.
(b) Demonstrating the visualization tools by the instructors using LCD projected on 6x6 feet screen.
(c) Each respondent was given 10 minutes to familiarize with the four visualization tools given on individual computer screen.
(d) The questionnaire booklets were distributed to the respondents and for them to answer the questions based on their experience using the visualization tools.
(e) The respondents were given an ample time to answer all the questions with maximum time of 45 minutes.

5. Results and conclusion

This research has shown that the level of perception of human being was associated with the advancement of the technology and consideration of other important factors such as individual knowledge and exposure on the visualization tool. Majority of the respondents have similar preference of visualization tools. Digital picture was commented to be the easiest tools whereas the interactive visualization tool was the hardest to use. Most of the respondents agreed that static visualization was much easier to use compared to the dynamic visualization that required special instruction or skills to navigate. In comparison to the level of interactions between static and dynamic visualization tools, most respondents chose dynamic tools due to the flexibility of visual exploration. On contrary, digital stills was the least preferred choice since its limited choice of viewing experience. It was interesting to note that the most commonly used was not necessarily to be the best choice of visualization tool.

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