International Seminar and Workshop on Urban Planning and Community Development
IWUPCD 2017: 18th-22nd September 2017
ISBN: 978-602- 5428-06- 7| Pg. 161-168

Parametric Isovist Analysis to Determine Visibility and Quality of Urban Surveillance in Public Open Space Case Study: Bundaran Hotel Indonesia Jakarta

Wafirul Aqli[1]

[1] *Department of Architecture, Universitas Muhammadiyah Jakarta, Indonesia*
wafirul.aqli@ftumj.ac.id

ABSTRACT

Public open space is a space or area that is vital for the urban citizens, because there is a variety of activities that support various aspects of urban life. Urban dynamics such as space users, form of activities, and others affect several factors such as security factor. Surveillance of the public open space is needed in order to maintain common security within the city. In addition to security, surveillance functions can also be used to control the problem of space limitations such as traffic congestion or inappropriate use of space by the users. Bundaran Hotel Indonesia is one of public open spaces in Jakarta in the form of roundabouts and intersections, as well as spaces for pedestrian and communal activities that are vital for the citizen of Jakarta. The dynamics that occur are often encountered some problems of traffic congestion, and communal activities such as politic rallies or demonstrations, to the car-free-day event which involve a lot of people. Safety factor surely becomes an issue in this area so that better supervision of the public spaces is needed.
The quality of the surveillance performed both directly by the security officers and/or the facility of CCTV camera are influenced by the level of visibility within the public space. Isovist analysis in this article is done by computerized method to determine the visibility. Isovist is an analysis to know the visibility of space seen from the position of the observer and the form of space that affects the visibility of the observer. The level of visibility is represented by two-dimensional polygons forming the viewing zone, and its shape is influenced by the openness of the space. To facilitate the rapid analysis, parametric methods are also used in this computerized isovist so that the various possible positions of the observer can be simulated with more dynamic, however complex the shape of public space, as well as the area of Bundaran Hotel Indonesia.

Keywords: *Visibility, Public Space Surveillance, Isovist Analysis, Parametric Method*

1. Introduction

This article is trying to compile materials of understanding about visibility analysis in the first phase of research on visibility within open public space. This phase is to conclude hypothetically about how to perform the analysis in the chosen case study.

Public open space is a space or area that is vital for the urban citizens, because there is a variety of activities that support various aspects of urban life. Urban dynamics such as space users, form of activities, and others affect several factors such as security factor. Surveillance of the public open space is needed in order to maintain common security within the city. In addition to security, surveillance functions can also be used to control the problem of space limitations such as traffic

ISBN: 978-602- 5428-06- 7| Pg. 161-168

congestion or inappropriate use of space by the users.

The quality of the surveillance performed both directly by the security officers and/or the facility of CCTV camera are influenced by the level of visibility within the public space. Isovist analysis in this article is done by computerized method to determine the visibility.

2. Definitions

2.1. Urban Visibility

One of the factors that defines spatial experience and cognition of architectural/urban space is visual perception of space. Impact of design decisions on perception of space may help to signifcantly improve the quality of urban developments, Koltsova (2013) quotes this statement from Bittermann (2008) [1][2].

Visual perception is often thought to be the most significant issue among all types of human's perception [3]. Urban image dominates human senses as the observer of urban space. The image are considered to be various from each person, influenced by human's knowledge background and activity within urban space. In research field this type of sense introduced as visibility analysis, after the conception of isovist appear.

The isovist methodology and the development of analytic measurement of the properties to be applied for describing spatial environment quantitatively was first conducted by Benedikt in 1979 [4]

Gewirtzman compiled a number of researchers which have developed measurement methods and tools for automated 'Isovist' analysis; among them Alan Turner in 2003 showed how a set of Isovist can be used to generate a graph of mutual visibility between locations, through that method he developed the Depthmap application for visibility graph analysis.

Michael Batty in Gewirtzman described how a set of 'Isovist' forms a visual field whose extent defines different 'Isovist' fields of different geometric properties. From his study, isovist fields can be measured with computational scheme and visualize it in spatial and statistical properties using maps and frequency distributions.

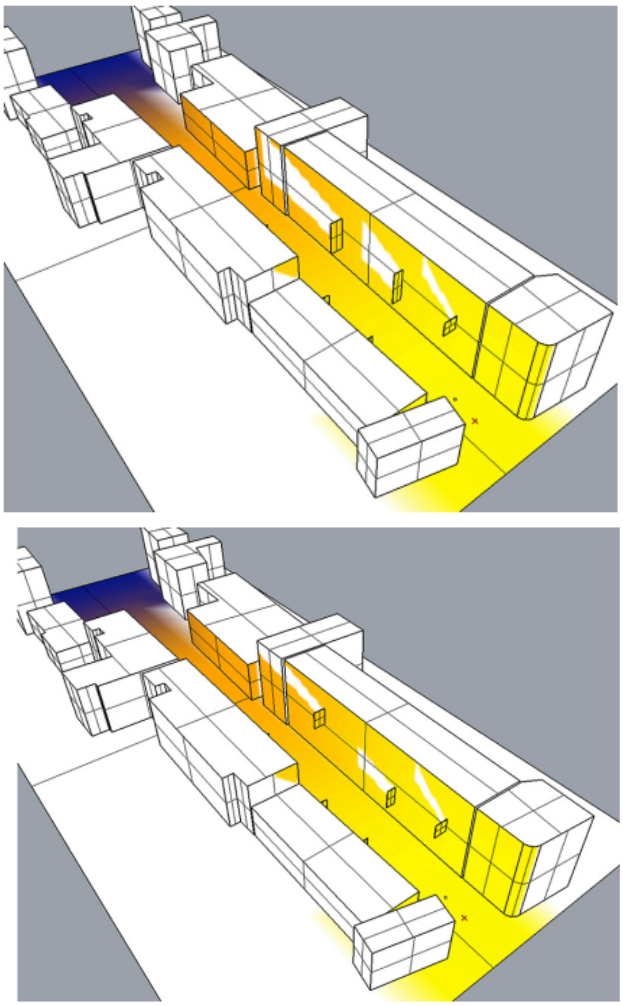

Figure 1: An example of visibility analysis in urban corridor, to study visual pollution by advertisement billboards. Source: (Koltsova, 2013)

ISBN: 978-602- 5428-06- 7| Pg. 161-168

In the field of architecture and urban design, the most common of utilizing visibility methods and tools are analysis of important/strategic points such as transportation hub, public spaces, monuments, etc., which can help to improve navigation of pedestrians in the city. Another case is the preservation and/or strategic use of views to natural landscape elements such as a river or park [1].

Quoting from Koltsova, Tuncer and Schmitt (2013); the most recent visibility analysis methods that designers and architects use today rely heavily on computing power. Some of the well-known analysis software such as, Ecotect, Space Syntax and ArcGIS offer methods for visibility analysis. All of those software are standalone applications that do not support 3D modeling. Every new design version must be imported and analyzed in a modeling software. This approach does not support dynamic manipulation of the design model and slows down the design process [1]. From this issue, parametric function and plugin in 3D modelling application are needed. Parametric method could make changes in model dynamically and revised models analyzed by the tool in real time. One of the parametric plugin that attached to 3D modelling applications is Grasshopper in Rhinceros modelling platform.

2.2. Isovist

An isovist is a field of vision from which various geometrical properties which can be calculated, such as area and perimeter. Isovists can be defined for every vantage point constituting an environment, and the spatial union of any particular geometrical property defines a particular isovist field. Batty said that the only work that has sought to extend these ideas has concentrated on the shape of isovists within their fields [5].

In connection with isovist analysis, the Spatial Openness Index (SOI) or also be described as a 3D Isovist could explore the 3D visibility and permeability of spatial configurations. It was the first real attempt to simulate human three dimensional visual perceptions according to Gewirtzman. SOI measurements of alternative spatial configurations were correlated with comparative perceived density [4].

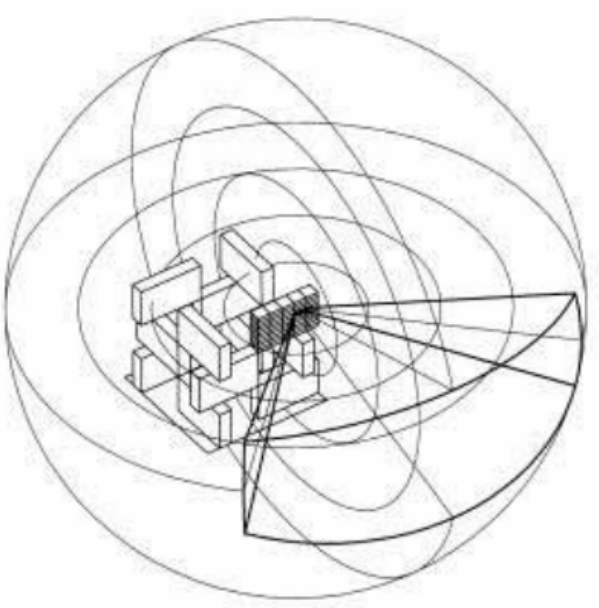

Figure 2: Spatial openness index (SOI) is the visible part of a sphere from given point of view
Source: (Gewirtzman, 2003)

The quality index in quantitative terms can provide a comparative spatial quality evaluation of various spatial configurations. Our quality index actually refers to the volume

ISBN: 978-602- 5428-06- 7| Pg. 161-168

of free space, which is observed from a specific viewer's position [4].

2.3. Security and Surveillance

From Cottrill; Security may be approached from the two primary directions of deterrence and response. Under this approach, deterrence may be evaluated in terms of lessening the chance of a malicious attack, while response may be understood as the ability to use collected data for purposes of law enforcement, such as strengthening a case against a suspect with recorded footage of his or her involvement in an incident [6].

Lee and Nevatia stated that; Video surveillance camera have been used for various applications such as traffic monitoring, security system, post incident analysis, etc. Originally these video surveillance systems were designed for human operator to watch concurrently or to record video data as archive for later analysis. As the amount of cameras is significantly increasing and the quantity of the archived video data becomes unmanageable by human operator, intelligent video surveillance systems have been introduced. Recently, computer vision researches have been heavily involved in intelligent video surveillance applications [7].

3. Case Study

Bundaran HI area which was originally a suburb area, which opened to become the gate of international sports competition competition Asean Games in Senayan, has shifted to the city center. HI area in its development has become the center of economy and modernization. Collected in this area of offices and shopping centers of middle-upper class, so this area became the center of public interest in addition to the National Monument as a city landmark.

Bundaran HI area as the focal point of downtown Jakarta is an area with great property investment opportunity, because it is the target area of multinational companies. It is projected that over the next few years the region's development will continue to include economic and office functions [8].

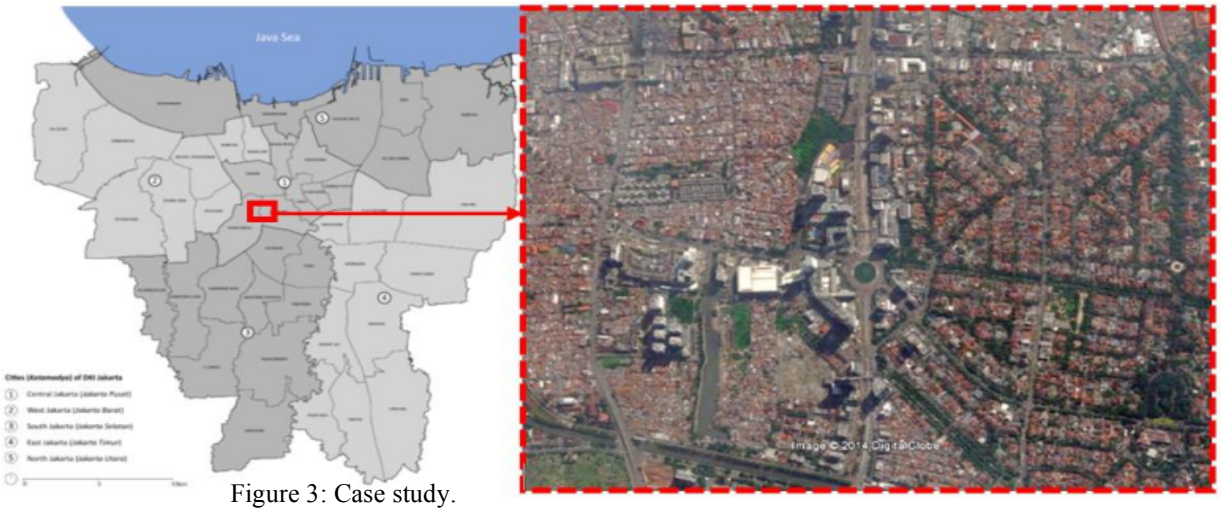

Figure 3: Case study.
Source: (Author, 2016)

ISBN: 978-602- 5428-06- 7| Pg. 161-168

Scope of the location to be studied is the area of roundabout, covering the north and south sides of Jl. MH. Thamrin along comfortable walking distance (± 400 meters) to the limits of public transport stop. Limits on the eastern to western sides are some of the land with residential, office and commercial functions that are also located at a comfortable walking distance (± 400 meters).

4. Methodolgy

Adopting the theory from Rapoport (1997) [9], Gewirtzman create some assumption to assessing the spatial quality that influenced from degree of density; *Low perceived density contributes to high spatial quality and a high qualitative environment as people usually see low perceived density as one of the characteristics of a high-quality environment. At the same time, we assume that a spacious environment with high spatial openness would also contribute to the quality of space and specifically to the perceived density*.

Stages of research that will be pursued are as follows:

1. Research Preparation Phase. This stage consists of a study, survey and initial data collection consisting of: literature review, preliminary survey, data collection of the exciting conditions.
2. Research Stage. This stage consists of: Collection of field data, Documentation of field conditions related to position of surveillance, and Mapping the pattern of physical aspect such as building and other.
3. Processing and Presentation Phase Data, consisting of: Data processing, Assessment of calculated tabulated, and Presentation of data with tabulation summary forms, graphs and maps.
4. Stage Analysis and Discussion. This stage is done by interpreting the results of analysis and data processing.
5. Conclusion Withdrawal Stage. At this stage the results of the analysis and discussion are used as the basis for formulating conclusions and recommendations

4.1. Parametric Scheme

To evaluate views from a surface, such as façade, this study using Rhino 3D modelling called Ladybug 'View Analysis' component or also known as 'View Rose' function. The component will allow you to run the analysis using either view type or points. A view type is

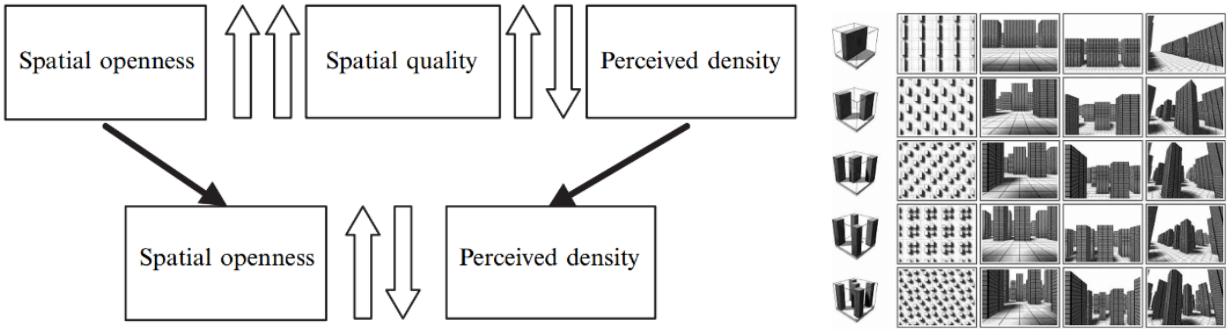

Figure 4: Scheme and illustration about SOI measures. A high measure of spatial openness index can indicate low perceived density Source: (Gewirtzman, 2003)

ISBN: 978-602- 5428-06- 7| Pg. 161-168

an integer representing the type of pre-generated view analysis that you would like to conduct [10]:

0 = Horizontal Radial. The percentage of the 360 horizontal view band visible from each test point. Use this to study horizontal views from interior spaces to the outdoors.

1 = Horizontal 60 degree cone of vision. The percentage of the 360 horizontal view band bounded on top and bottom by a 30 degree offset from the horizontal (derived from the human cone of vision). Use this to study views from interior spaces to the outdoors. Note that this will discount the '_geometry' from the calculation and only look at '_context' that blocks the scene.

2 = Spherical. The percentage of the sphere surrounding each of the test points that is not blocked by context geometry. Note that this will discount the '_geometry' from the calculation and only look at '_context' that blocks the scene.

3 = Skyview. The percentage of the sky that is visible from the 'input _geometry'.

The definition scheme of grasshopper plugin to create visibility representation in Rhino 3D model which used in this study:

References

[1] Koltsova A, Tuncer B, Schmitt G. *Visibility Analysis for 3D Urban Environments*. eCAADe 31 - Computation and Performance - Volume 2 - Models of Computation: Human Factors p. 375-384. 2013.

[2] Bittermann, M S, Ciftcioglu, O. *Visual Perception Model for Architectural Design*. Journal of Design Research, Vol. 7, pp. 35-60. 2008.

[3] Lin, T P, Lin, H, Hu, M Y. *3D Visibility Analysis in Urban Environment – Cognition Research Based on VGE*. ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Vol. II-2/W1, p.227-236, ISPRS 8th 3DGeoInfo Conference & WG II/2 Workshop, 27 – 29 November 2013, Istanbul, Turkey

[4] Gewirtzman, D F, Natapov A. *Different approaches of visibility analyses applied on hilly urban environment*. Survey Review Ltd Vol. 46 No. 338; 201, p. 366-382.

[5] Batty, M. *Exploring isovist fields: space and shape in architectural and urban morphology*. Environment and Planning B:

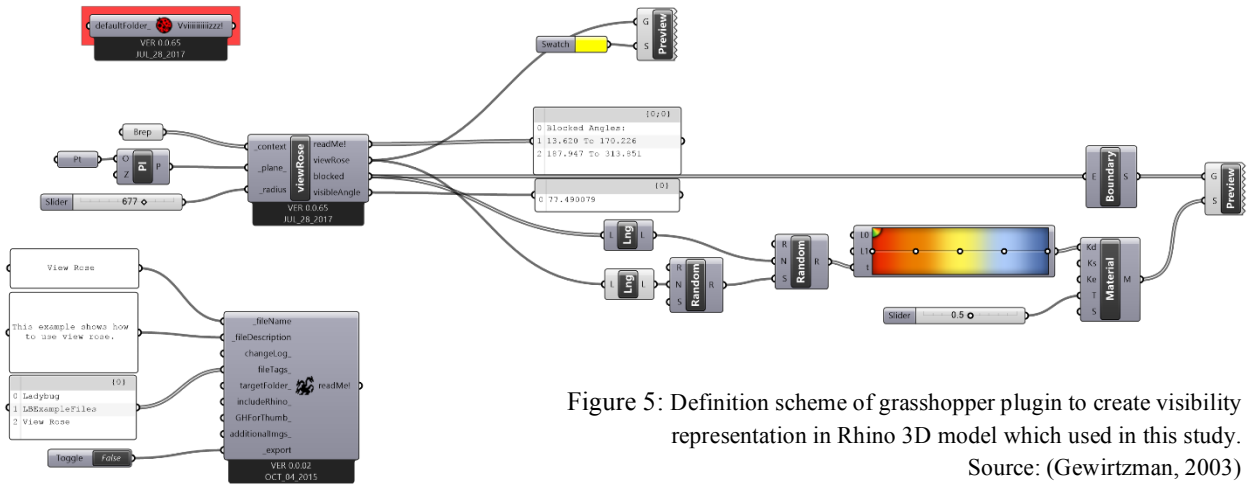

Figure 5: Definition scheme of grasshopper plugin to create visibility representation in Rhino 3D model which used in this study.
Source: (Gewirtzman, 2003)

ISBN: 978-602- 5428-06- 7| Pg. 161-168

Planning and Design, volume 28, p. 123-150. 2001.

[6] Cottrill, C D, *Examining privacy and surveillance in urban areas: a transportation context*. Urban Trasnportation Center, Chicago.

[7] Lee, S C, Nevatia R. Robust Camera Calibration Tool for Video Surveillance Camera in Urban Environment. Institute for Robotics and Intelligent Systems, University of Southern California. 2011.

[8] Aqli, W. *Accessibility of pedestrian way in the area of Bundaran Hotel Indonesia Jakarta using space syntax application*. Thesis; Universitas Gadjah Mada, Study Program Master in Architecture. 2017.

[9] Rapoport A. *Human aspects of urban form*. Pergamon, Oxford. 1977.

[10] Wintour P. *Advanced – Ladybug View Analysis*.https://parametricmonkey.com/2016/01/21/view-analysis/. Accessed December 2017

ISBN: 978-602- 5428-06- 7| Pg. 161-168

(This page is intentionally left blank)