Finding Ways in an Unfamiliar Tourist Destination: Salient Clues for Visitors to a Malaysian Town

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Abstract: Nowadays, way-finding have become popular and warmly researched in modern urban environment. A critical consequence of navigational tasks can be known as a distracting dilemma which may cause excessive discomfort to passengers. Landmarks are the most important components as crucial guiding principle to lead users from one point to the next. In this work, though a numerical approach on a case study, an analytical method as a comparative research on a comprehensive study of landmark saliency measurement is investigated. According to the principles of the study, Muar town located at Malaysia is sought. By comparison of obtained results from numerical analysis with close formed one, a communicational value as a modified coefficient is proposed to identify the most real effective landmarks. In addition, the effects of age and gender differences on people cognitive map have been revealed.

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1. Introduction

1.1 Way-Finding

Most people are encountered with finding the best way to reach to their destination. One definition for way-finding' is "the act of travelling to the destination by continuous processes of making route-choices whilst evaluating previous spatial decisions against stable cognition of the environment. For most ordinary person, the daily task of way-finding' involves finding destinations based on their knowledge of familiar places within their region [1]. Previous studies have focused on the anchor point hypothesis and tectonic plate hypothesis [19]. Darken & Banker [11], discussed about the virtual environment and how users can differentiate architectural or urban environment components, and how this knowledge is affected by disclosure duration. Moreover, some studies have researched age differences associated by memorizing the features of places, and also the different structural features affect the location rather than a verbal of memory of buildings [12] other studies have clarified the gender differences in way-finding' strategies [13]. In some cases, elements such as the degree of user familiarity to places or landmarks, the navigational behavior for newcomers in an unfamiliar environment, visual access and the classification of a landmark' formation have been investigated as factor that affect way-finding' [2], [5], [14], [3].

1.2 Landmark:

With respect to aforementioned literature, landmarks are considered the most significant component which can be use as reference for people to memorize and recognize routes, and guide them to their final destination [3]. In addition, landmarks can be regarded as major points of reference in terms of classifying cognitive space for people [6]. In the study on the status of tourism in the city of islamabad gharb strategic swat, J. Salimmanesh, B. Shafii and M. Emami (2012) revealed the importance of urban legibility and landmarks as one of main factors due improving tourism industry by notifying the lack of symptoms and signs guide visitors for tourist attractions as a weakness of tourist statuse and also highlighting the promotion of the unique monuments (as landmarks) of the city tourism as strategic factors due improving status of tourism [21]. It is important to insert objects as a landmark in a place. However, it is also significant that these objects are designed in a way that conforms to the traditional attributes of a landmark. There are two issues about the way in which landmarks should be built. One of the issues relates to the visual features of the landmark and the other refers to the semantic qualities. On the other hand, a landmark should be memorable for users as reference point in terms of navigational procedure. Thus, memorability is the main characteristics of landmarks and in particular, landmarks distinctiveness, has been found to be the chief attributable of its ability to serve as reference point. To date, a large volume of studies regarding landmark saliency measurements can be found in the literature.

Pausch and Burnette [16], suggested method that constantly provides perceptual cognitive while updating the view point by using techniques and World-in-Miniature (WIM). Provision of subspaces with smooth transition, a nonlinear motion control technique was implemented by Song and Norman [15] to provide a robust model of cognition. Furthermore, Omer and Goldblatt [17], applied a 3D virtual environment to examine the depth of topology and the overlap between the visual components of two landmarks. Parush and Berman [18], explored the user's ability to acquire spatial cognition in 3D user interface which depict an on-screen virtual environment. Additionaly, Bardia Yousefi, et.al [22] applyed a novel fuzzy based method to create 3D buildings modeling in urban satellite imagery. In other research, Bardia Yousefi, et.al [23] applied the Gabor filter and appropriate structure element along with morphological operation to the image as feature extraction method to detect few unknown road parts and classify to freeway along with one or two lane road based on structural profile according to the urban area satellite image object characteristics. Moreover, through 'pleasure of aesthetic place (landmarks)' Method, A. A. Ayu Oka Saraswati, et.al [24] revealed the aesthetic interpretation by experiencing pamedalan or pemesuan and the 'going out start from pamesuan' sacred rituals events. On the other hand, Liyoung hong [9] dealt with social network analysis and published a paper on the landmark saliency instructions in order to determine the landmark characteristics. By specifying a demographic analysis and applying social network analysis, a simple approach has been proposed to provide a satisfactory method to prevent the instruction of landmark saliency measurements. Similarly, Raubal and Winter [10] carried out a research in way-finding instruction by specifying landmark distinctiveness as a feature.

Nevertheless, the presented guideline methods are an approximation consideration of simplified models which are not used simultaneously to precisely simulate the formal method consisting of both demographic and formal results which are practically of primary concern.

Although, several studies have been done based on way-finding and landmark saliency measurement, there is an apparent lack of sufficient information in some details. Based on the review of existing literature concerning formal method, some factors, such as communicational value, have been neglected. In addition, the effect of user' penchants based on their culture and traditions are not investigated sufficiently.

In the present work, in order to address and investigate all the above mentioned aspects, a comprehensive study to apply social network analysis and the formal method based on case study of one place are considered. Comparison analysis regarding the results of both mentioned methods is investigated. Eventually, the similarities and differences of the results are highlighted and an accurate optimization of formal method is applied.

2. Case Study

Based on the aim of the study, the town of Muar, with a total population of 328,695 and covering over 2346.12 km2, was selected. As shown in Figure 1, it is located at the starting point of the Muar River and is about 150 km (93 miles) southeast of Malaysia's capital Kuala Lumpur, and about the same distance (179 km) northwest of Singapore [20].

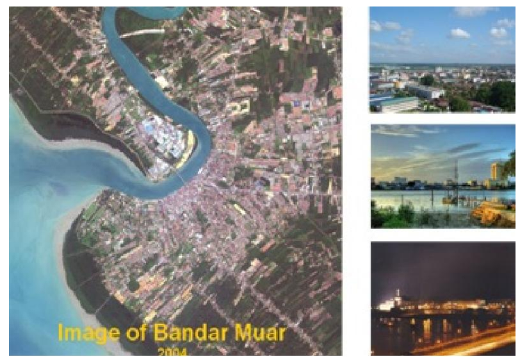

Figure 1 – Profile of the Town of Muar (Bandar Maharani [20])

3. Analysis Method

The aim of this study is to implement two methods (social network analysis [9] and the formal method [10]) based on one case study. As a result, optimization for the formal method is applied by comparing the results from each part of analysis. The following section will discuss the analysis of both methods.

3.1. Social Network Analysis

The goal of this study, with the aid of the application of social network analysis, is to identify what places are frequently used in a community and how these places are structured. The first stage is to note the anchor type landmarks that are strongly related to a users' navigation such as shopping mall, grocery stores and restaurants. The next stage is to evoke the spatial knowledge of the respondents from these anchor points, a process which is highly dependent on self-own cognitive maps available at that time. The cognitive maps consisted of the places visited frequently rather than visually salient geographical features. Mostly, these places are introduced to the community by way of social communication. According to Llyoung hong [9], the analysis procedure for applying social network analysis consists of two parts. The first part of is connected to the demographic analysis which involves gathering together some notable places which can be considered as landmarks. For this aim traditional survey knowledge was prepared in order to obtain information about which places are perceived as landmarks by the community. By choosing Muar as case study, the survey analysis was prepared. The survey analysis consisted of 40 respondents who are residences of Muar. The survey analysis was carried out to evaluate each resident's cognitive map to determine how residents conceptualize the town. In addition, in order to gouge the value of the study area, the quantitative and qualitative interview was applied. Respondents were asked to fill up the survey forms. The survey questionnaires collected data such as the respondents' familiarity with the place. For geographical analysis of respondent's familiarity, 70 places were collected from a pilot study, which was undertaken with long term residents of the town in order to identify relevant issues about the place. Out of the 70 mentioned places, respondents were asked to choose the 10 most familiar places, and to measure the amount of familiarity with these places, respondents were asked to evaluate the 10 chosen places. By following Gale's four dimensions of familiarity [7], this study used five familiar indexes as a guide for familiarity measurement. Gale [7] categorized four dimensions of spatial familiarity into four; spatial, visual, naming and interaction. The first is the sense of spatial knowledge or knowing where a place is. The second is the ability to recognize a place when shown an image of it. The third is a process of labeling. The fourth is the interaction of frequency and overall, interaction proved to be the most distinctive. These four indexes were used to measure the spatial familiarity of the places. For the statistical analysis, a 1-5 scale was applied and the survey results were converted to matrices. As a weighted matrix, each place has 1-5 degree by subjects. Subjects were instructed to give these scores according to the familiar index. With the weighted matrix, the familiarity is scaled from 1 (low level) to 5 (high level). The next step of analysis entailed the evaluation of 30 places that were collected, ranging from the most to the least well-known places. The results from survey questions were included road names such as JALAN SULAIMAN, and JALAN MAHARANI. The objects were limited to 30 places in order to the cost of analysis and presentation when applying social network analysis (see Table 1)

The index 5 means that there is frequent interaction with the community members. Thus, the list of places can be transformed as matrixes that have a value of 0 or 1. In other words, place by person matrix can be assumed as the affiliation of a set of community members placed in columns, and with a set of places in rows. Table 2 and 3 presents the affiliation matrix of Muar's community.

Table 1: List of Places for Social Network Analysis

ID	Name	ID	Name
01	WETEX COMPLEX MALL	16	JALAN ABDULLAH
02	CLOCK TOWE	17	JALAN ARAB
03	RIVER FRONT	18	JALAN MARIAM
04	SULTAN ISMAIL BRIDGE	19	TANJUNG KETOPONG
05	MUAR TRADE	20	MASJID SULTAN IBRAHIM
06	TANJUNG MAS MUAR	21	JAMBATAN SULTAN ISMAIL
07	JALAN SULAYMAN CHINA TOWN	22	JALAN PETRI
08	BUS STATION MUAR	23	COURT BUILDING
09	ASTAKA SHOPPING COMPLEX	24	TRADE HOTEL
10	JALAN JONEID, TANJUNG EMAS	25	JALAN ALI
11	POLICE STATION	26	D'99 HOTEL
12	SHOPPING COMPLEX LAGENDA	27	BENTAYAN FOOD COURT
13	CLASSIC HOTEL	28	JALAN MAHARANI
14	JALAN BENTAYAN	29	STADIUM JALAN TEMENGGANG
15	JALAN SISI	30	THE SEA SIDE

The matrix was generated for social network between landmarks and community members from the survey data. Figure 2 shows the translation method. In the case of familiarity index, the index 1-4 was assigned with value 0 and index 5 with 1.

Survey Results

	a	b	c	d
1	5	5	4	5
2	5	1	1	1
3	3	3	4	5
4	1	1	1	5

➡

Person vs. Place

	a	b	c	d
1	1	1	0	1
2	1	0	0	0
3	0	0	0	1
4	0	0	0	1

➡

Place vs. Place

	a	b	c	d
a	2	1	0	1
b	1	0	0	0
c	0	0	0	0
d	1	0	0	3

Figure 2 – Transformation from Place-by-Person to Place-by-Place Matrix [9]

Table 2: Affiliation Matrix (a,b,c.. are the Id of Subjects and 1,2,3.. are Id of Places(A-W))

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
1	0	1	0	1	0	1	1	1	0	1	0	1	0	1	0	0	0	0	0	0	1	0	0
2	0	1	1	0	0	0	1	0	0	1	0	0	0	1	1	0	1	0	1	0	0	0	0
3	1	0	0	1	0	0	1	1	1	1	0	0	1	0	0	1	0	1	0	1	0	1	0
4	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
5	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0
6	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	0
7	0	1	0	0	1	0	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0
8	1	0	1	0	1	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0	0
9	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	1	0	0	0	0	0
10	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	1	1	1	1	0	0	0	0
11	0	0	0	1	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
12	1	0	0	0	1	0	0	0	1	1	0	0	0	1	0	0	0	0	0	0	0	1	0
13	0	0	1	0	0	0	0	0	1	1	0	0	0	0	0	1	0	0	0	0	0	0	0
14	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1
15	0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0
17	1	0	0	0	1	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	1	0	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	1
20	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
21	1	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0
22	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0
24	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	1	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	1	0	1	0	0	0	0	0	0	0	1	0	0	1	1	0	0	0	0	0	0	0	0
27	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0
28	1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
29	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0

In this matrix, row (1, 2, 3, 4 ….) is the list of landmarks and column (a, b, c, d …) is the list of community members. Assuming an m x n matrix (matrix A), where m places are measured by set of persons, if place i is frequently interacted with by a person, the matrix entry (Aij) is equal to one. Otherwise, it would be zero. The fact that place i is familiar to person j reveals each place's attributes.

Table 3: Affiliation Matrix (a,b,c.. are the Id of Subjects and 1,2,3.. are Id of Places(X-AO))

	X	Y	Z	AB	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO
1	1	1	1	0	0	1	0	0	1	1	0	0	1	0	0	0	1
2	0	0	0	0	0	1	1	0	0	0	1	0	0	1	0	1	1
3	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	1	1	0	0	0	1	0	1	0	0	1	0	1	0	1
5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	1
12	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
14	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0
15	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0
16	0	0	1	0	1	0	0	1	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	1	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0
26	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0
29	0	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0	1
30	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1

To build an affiliation matrix, the top 30 places from each of the survey list was selected and the affiliation matrix was composed with 30 places by 40 subjects. To build a network, a place-by-place matrix can be structured using transpose matrix. Place-by-place matrix was used to visualize and categorize the structure of familiar places. The place-by-place matrix indicates how people are familiar with both row place and column place. The larger the entry of matrix means, the more people are familiar with the row place and column place. At the affiliation matrix of places, the value of matrix indicates the number of persons who know the row and column places. The UCINET 6.0 [8] social network analysis software was employed to analyze the network data and the index properties of network and to calculate centrality measures. To explore the person-place affiliation relationships, two-mode network analysis was applied [8].This analysis allows us to examine the interrelationships between data and the result is shown to have structural characteristics, which affect a community's behavior within a certain area. In general, the major concern of social network analysis is the relative power and prestige of components or nodes among the social networks. When the nodes are involved in the various activities, they are connected to the others and the social network is organized. Thus, relationship characteristics, which mean how nodes are connected to each other, are essential. One of the important concepts in social network analysis is the measure of centrality. There are several ways to measure centrality. Firstly, degree centrality shows the degree to which each individual node is linked with the others. Basically, nodes that have a large number of links play central role in network relationship. However, there are criticisms about the degree of centrality measures as they consider only the main ties that a node has instead of the oblique ties to all others. There are ways to address this shortcoming. The first is betweenness centrality, which measures the degree that one node can be located between the other nodes. Betweenness centrality considers a component as having a favorable arrangement to the level that the component locates on the geodesic paths among other pairs of components in the set of connections. The node is seen to have control over the flow of information in the set of connections when the degree of betweenness is high. The second measure is eigenvector. Eigenvector of the geodesic distance means the way a node is connected to the nodes that have a higher central role. Eigenvector is an endeavor to evoke the highest degree of central components regarding the wider structure of the set of connections. These centrality measures are related to concepts such as power or prestige and they can be utilized as dependent or independent variables in statistics. This study is focused on the set of connections that is created from the perceptual relationship between community members. In this network, a high value of degree centrality means that the landmark has may links to community members. In other words, the landmark is known to most people. A high degree of betweenness centrality means that the landmark has an important bridging role, regardless of the number of people who know that place. Finally, a high value of eigenvector centrality dose not simply means that large numbers of people know the place. Instead, it has many connected to high well-known places. In other words, the landmark is known to the people who know highly centralized places.

3.2. Formal Model Analyses

3.2.1. Introduction

Navigational tasks involve the most advantageous routes by providing the instructions for these routes. These instructions guide navigators from one point to the next. This part of the analysis addresses the formal model by applying some navigational instruction models and calculating the distinctiveness of the landmarks in MUAR TOWN. The main goal is to extract the suitable features of notable places (e.g. landmarks) between all existing datasets. According to Raubal and Winter [10], the point of interest (POI) is defined as a geo-code in spatial dataset. Based on POI, they have provided the method to measure the attractiveness and the salience of the landmarks.

3.2.2. Measures for the Distinctiveness of Notable Places

Formal model analysis calculates the saliency of Semantic Attraction (e.g. Cultural and Historical significance and Explicit Marks) Visual Attraction (e.g. Façade, Shape, Color and Visual Expression), and Structural Attraction (e.g. Boundary statements and Nodes). The following section will describe the way to calculate each of the salient components.

3.2.3. Visual Attraction

Landmarks are deemed visually attractive if their visual characteristics, including factors such as the contrast with their surrounding buildings, are notable. For example, landmark salient values may include aspects such as facade areas, shapes, or colors. The following section highlights the individual properties and describes the measurement of these properties.

A) Facade Area

Façade area is an important component to show the contrast of an object with its surroundings. People easily rely on buildings whose façade areas largely loom over or dominate the surrounding objects. So, by multiplying the width and height of façade, the facade area is calculated. Table 4 indicates how this is done.

Table 4: Facade in Visual Attraction and How It Is Measured

Properties For Visual Attraction	Measurement	Example (Riverfront Located At Muar Town)
Façade Area	α = height * width $\alpha = \int X \mid Y \in$ Facade	α = 4668m * 0m = 0sqm

B) Shape

The measurement of shape factor is considered by its deviation from the rectangle in which it is located and its shape factor. Shape factor relates to the amount of height and width of an object. Skyscrapers, for instant, contain a high shape factor in comparison to their surrounding buildings. The deviation of an object is calculated by considering the differences among the area of the smallest bounding rectangle of the façade and the objects' facade area. In some cases, two different shapes have the same deviation because the proportions in both cases are the same. Table 5 shows the measurement of shape factor and shape deviation.

Table 5: Shape in Visual Attraction and How It Is Measured

Properties For Visual Attraction	Measurement	Example (Riverfront Located At Muar Town)
Shape Factor	β_1 = height / width	β_1 = 0m / 4668m = 0sqm
Shape Deviation From Rectangle	β_2 = (Area Of smallest Bounding Rectangle - α) / smallest Bounding Rectangle	$\beta_2 = 0$

C) Color

The color of an object is the other factor which improves the landmark distinctiveness. Color factors are calculated by considering the decimal value from the RGB (Red, Green, and Blue) color chart which determines the differences between an object and its surrounding context. Although this may sound simple, measuring the color is difficult, especially when the surface of the object reflects light. However, for the current procedure, daylight specific illumination is taken as ordinary. Given a triple color value for all buildings in the neighborhood, a mean color can be estimated, and distances (L2 norm) from the mean can be calculated to test the hypothesis. Table 6 indicates the color measurement procedure.

Table 6: Color in Visual Attraction and How It Is Measured

Properties For Visual Attraction	Measurement	Example (Riverfront Located At Muar Town)
Color	γ = [R, G, B]	γ = [210, 230, 227]

D) Visibility

The prominence of the spatial location is the last measurement for visual attraction calculation. Two dimensional visibilities were proposed as a final measurement. Places that are applied in the real mobility type for pedestrians were considered as public streets with some private areas. The pre-defined buffer zone limited the considered space because it assumes that visibility is limited by recognizability. Visibility can be calculated by the area of the space which is enclosed by the hypothetical cone at the front of the building. Table 7 clarifies the way to measure visibility.

Table 7: Visibility in Visual Attraction and How It Is Measured

Properties For Visual Attraction	Measurement	Example (Riverfront Located At Muar Town)
Visibility	$\delta = \sum X \mid Y$ Visible	$\delta = 15636$sqm

3.2.4 Semantic Attraction

This section will consider the effect of culture and historical importance of the object and explicit marks. Semantic attraction can be deduced from the historical and cultural objects existing in archeological and architectural treasures.

A) Cultural and Historical Characteristics

As an example, according to Table 8, cultural and historical characteristics are calculated by assigning the Boolean value to each object (if the object consists of cultural or historical components: "T for True" and otherwise "F for False"). This measurement can be based on a scale of 1 to 5).

Table 8: Cultural And Historical Characteristics in Semantic attraction and How It Is Measured

Properties For Semantic Attraction	Measurement	Example (Riverfront Located At Muar Town)
Cultural And Historical Characteristics	ε □ {T, F} ε □ {1, 2,, 3, 4, 5} Scale Of Importance: 1 (High) – 5 (Low)	$\varepsilon = 1$ (Place Is Very Famous For Its Characteristics)

B) Explicit Marks

As shown in Table 9, the building explicitly deals with the visible traces such as the signs at the front of building. Explicit marks are measured by assigning the Boolean value to each object. For example, if the object consists of marks, it is valued as "True" or "False".

Table 9: Explicit Mark in Semantic Attraction and How It Is Measured

Properties For Semantic Attraction	Measurement	Example (Riverfront Located At Muar Town)
Explicit Mark	ζ □ {T, F} Boolean	$\zeta = T$ (Sign On Front Of Place)

3.2.5 Structural Attraction

Landmarks could be distinctive if they have a salient location as a structure in the spatial environment and play a pivotal urban role in their space. In this study, structure deals with the travel network of a traveler by defining the mode of transportation. According to Lynch [2], the structural elements which should be perceived as salient structural components in an environment are: nodes, boundaries (edges), and regions (districts). The structural measurement for each individual property is indicated below.

A) Nodes

Intersections are structural travel networks in an environment. Each type of user conceives these networks differently. The degree of node connectivity (in terms of graph theory) is the central structural feature of the node. As seems in Table 10, the degree could be measured by the quality of incoming and outgoing edges. For instance, by using the hierarchy of the street networks, the difference between two increasing highways and two increasing lanes is recognized. For weighting the quality of each street network, scaling the types of streets with 5 for highways, 4 for state streets, 3 for overland streets, 2 for town streets and 1 for footpaths can be used.

Table 10: Nodes in Structural Attraction and How It Is Measured

Properties For Structural Attraction	Measurement	Example (Riverfront Located At Muar Town)
Nodes	$\eta = (i + o)$ Weighted Incoming (i) And Outgoing(o) Edges To And From The Node W = The Type Of Street	$\eta = 0$

B) Boundaries

The measurement of the structural boundary component relates to the energy that users expend to cross them. For instance, the river in Muar separates two districts and users can cross this river by using one of two bridges. The river is seen as a barrier, forming an important visual element in maps of the city. Travel networks show cells covered with large boundary edges with a small distance between opposite edges. As shown in Table 11, the structural landmark saliency of the objects in these cells is characterized by the measurement of the product of cell size and their factors.

Table 11: Boundaries in Structural Attraction and How It Is Measured

Properties For Structural Attraction	Measurement	Example (Riverfront Located At Muar Town)
Boundaries	θ = Cell Size * Form Factor Form Factor = Long Side / Short Side	θ = 7249sqm * 6.07 = 44001.43sqm Form Factor = 5228m / 861m = 6.07

Table 12 shows the Calculating the Total Value of Landmark Saliency for a Feature.

Table 12: Calculating the Total Value of Landmark Saliency for a Feature

Measure	Property	Value	Significance (Property)	Significance (Measure)	Weight	Weighted Significance	Total
Visual Attraction	α	.....	S_α	$S_{VIS} = (S_\alpha + S_{\beta1} + S_{\beta2} + S_\gamma + S_\delta) / 5$	W_{VIS}	$S_{VIS} * W_{VIS}$	$S_{VIS} * W_{VIS} + S_{SEM} * W_{SEM} + S_{STR} * W_{STR}$
	β1	.....	$S_{\beta1}$				
	β2	.....	$S_{\beta2}$				
	γ	.....	S_γ				
	δ	.....	S_δ				
Semantic Attraction	ε	.....	S_ε	$S_{SEM} = (S_\varepsilon + S_\zeta) / 2$	W_{SEM}	$S_{SEM} * W_{SEM}$	
	ζ	.....	S_ζ				
Structural Attraction	η	.....	S_η	$S_{STR} = (S_\eta + S_\theta) / 2$	W_{STR}	$S_{STR} * W_{STR}$	
	θ	.....	S_θ				

Table 13 shows the Calculating the Total Value of Landmark Saliency for Riverfront Located at Muar Town.

Table 13. Calculating the Total Value of Landmark Saliency for Riverfront Located at Muar Town

Measure	Property	Value	Significance (Property)	Significance (Measure)	Weight	Weighted Significance	Total
Visual Attraction	α	0	0	$S_{VIS} = (0+0+0+1+1) / 5$	1	0.4 * 1	0.4 + 1 + 0.5 = 1.9
	β_1	0	0				
	β_2	0	0				
		210					
	γ	230	1				
		227					
	δ	15636	1				
Semantic Attraction	ε	T	1	$S_{SEM} = (1+1) /2$	1	1 * 1	
	ζ	T	1				
Structural Attraction	η	-	0	$S_{STR} = (0+1) / 2$	1	0.5 * 1	
	θ	7249	1				

3.2.6 The procedure of Finding Landmarks

The distinction between the feature attributes and the attributes of other features is very important in the context of a landmark's salient qualities or distinctiveness. A landmark should be distinct from other features. So in this study, the features that are within close proximity of the landmarks are measured. Mathematical calculation eases the procedure used to find the most prominent landmark among other landmarks by exploiting the maximum or minimum value in each attribute. Finally, it can be calculated for the total of all attributes grouped together. By assuming that these measures are a continual and normal provision, the evaluation can be applied by deriving the meaning of deviations from the local mean features.

By using the general form of the object, it is possible to earn the normal distinction for some of the features. For additional assumptions such as outliers (i.e. landmarks), the mean estimate is determined by the average of all local observations and where the paradigm of deviation can also be calculated. Both mean and paradigm deviation depend on the meaning of the local vicinity. This meaning should be related to the users' perceptual ability in the specific mode of travel (for instance, the pedestrian district should be selected smaller than that designated for car drivers). Calculation of the parameters of a distribution is done only once and then updated only when there are changes in the local environment, which is a rare occasion. It means that the local neighborhood which is associated with each function could be similar to other operations. The procedure for choosing a rectangle of each side depends on the mode of travel. It hypothesizes that feature attributes deviates from the local mean. If the hypothesis is rejected, the attribute feature is relatively similar with its near features. On the other hand, if the hypothesis is accepted, the feature has a landmark saliency that is related to the attribute which was examined. Type I errors (rejecting the hypothesis is correct) relate to the distinctive characteristics that are not detected. Type II errors (accepting a wrong hypothesis) relate to the landmarks that are not functioning as a distinctive sign for the place. Type II errors are too costly because they are related to the features that were supposed to define a landmark but which are not functional.

3.2.7 Combination of Values for Measuring Landmark Saliency

The next step for measuring landmark saliency is to combine all mentioned formula into one complete dataset. First, the vector of the value of each feature is selected (see table 3.12). Then, the local value and standard deviation for each feature is calculated. Local mean and structural deviation are factors of the hypothesis test that indicate whether the value is notable: (s=1) or not (s=0). The vector of notable value could be grouped by semantic, visual and structural significance. Finally, a total measure for landmark saliency can be estimated by determining the weights in advance for each group. The determined weights can be adapted according to the context (mode of travel) or individual user preferences. Table 12 and 13 shows the total value calculation for the Muar riverfront.

4. Results

4.1 Social Network Analysis

As mentioned, two methods are implemented to measure landmark saliency. Social network analysis was the first method used to derive the most central or distinctive landmarks in Muar. The UCINET software is applied to determine the degree of centrality, diversity and betweenness for each chosen landmark. To generate the results, the matrix that was identified between persons by places was transferred to matrix between places by places. Tables 14 and 15 show the affiliation matrix of the community of Muar on a place by place basis. As discussed, the place by place matrix presents the structure of familiar places. It indicates the degree to which people are familiar with places in the rows and columns of the matrix. The bigger the matrix entry, the more people are familiar with the place as indicated in the rows and columns of the matrix. So the matrix, place by place, shows the number of people who are familiar with each individual place.

Table 14: Transformation from Place-by-Person to Place-by-Place Matrix (1-15)

No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	17	6	5	4	3	4	4	2	2	2	4	3	2	1	3
2	6	14	2	1	1	3	2	3	1	4	5	2	3	1	0
3	5	2	13	0	3	3	1	2	3	2	4	4	3	2	1
4	4	1	0	9	0	0	0	0	0	0	1	1	1	2	3
5	3	1	3	0	5	1	1	1	2	1	2	3	1	1	0
6	4	3	3	0	1	6	1	1	1	1	2	1	0	0	0
7	4	2	1	0	1	1	5	2	2	3	0	2	0	0	2
8	2	3	2	0	1	1	2	6	2	2	1	3	2	1	1
9	2	1	3	0	2	1	2	2	5	3	0	2	1	2	0
10	2	4	2	0	1	1	3	2	3	7	0	2	1	1	1
11	4	5	4	1	2	2	0	1	0	0	7	2	3	0	0
12	3	2	4	1	3	1	2	3	2	2	2	8	2	1	1
13	2	3	3	1	1	0	0	2	1	1	3	2	5	0	0
14	1	1	2	2	1	0	0	1	2	1	0	1	0	5	1
15	3	0	1	3	0	0	2	1	0	1	0	1	0	1	5
16	2	1	2	2	1	0	1	0	2	2	0	1	1	0	0
17	2	0	3	0	1	1	3	3	2	1	0	2	0	1	2
18	4	2	2	1	0	1	1	1	0	0	1	3	1	0	1
19	2	1	3	2	2	2	0	0	0	0	3	1	1	1	1
20	4	1	2	1	0	0	1	0	0	1	0	0	0	0	1
21	1	2	2	0	1	1	2	3	1	3	0	2	0	1	2
22	3	3	2	1	1	2	1	1	0	2	2	0	0	1	0
23	2	1	2	1	1	0	0	0	1	1	1	0	0	1	0
24	2	2	1	2	1	0	2	1	0	2	2	2	2	0	1
25	3	2	1	1	0	0	2	0	0	1	0	0	0	1	1
26	1	3	1	1	2	0	1	2	2	1	0	2	1	1	1
27	3	1	4	0	1	2	0	1	0	0	2	3	1	0	0
28	2	2	2	1	1	1	1	1	1	1	1	1	0	1	1
29	3	4	1	2	0	1	0	0	0	0	3	0	1	1	1
30	3	2	2	1	1	1	0	0	0	1	2	1	2	0	0

Table 15: Transformation from Place-by-Person to Place-by-Place Matrix (16-30)

No	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	2	2	4	2	4	1	3	2	2	3	1	3	2	3	3
2	1	0	2	1	1	2	3	1	2	2	3	1	2	4	2
3	2	3	2	3	2	2	2	2	1	1	1	4	2	1	2
4	2	0	1	2	1	0	1	1	2	1	1	0	1	2	1
5	1	1	0	2	0	1	1	1	1	0	2	1	1	0	1
6	0	1	1	2	0	1	2	0	0	0	0	2	1	1	1
7	1	3	1	0	1	2	1	0	2	2	1	0	1	0	0
8	0	3	1	0	0	3	1	0	1	0	2	1	1	0	0
9	2	2	0	0	0	1	0	1	0	0	2	0	1	0	0
10	2	1	0	0	1	3	2	1	2	1	1	0	1	0	1
11	0	0	1	3	0	0	2	1	2	0	0	2	1	3	2
12	1	2	3	1	0	2	0	0	2	0	2	3	1	0	1
13	1	0	1	1	0	0	0	0	2	0	1	1	0	1	2
14	0	1	0	1	0	1	1	1	0	1	1	0	1	1	0
15	0	2	1	1	1	2	0	0	1	1	1	0	1	1	0
16	5	0	0	0	1	0	0	1	0	0	1	1	0	0	0
17	0	5	1	0	0	3	0	0	1	1	1	0	2	0	0
18	0	1	5	0	0	1	0	0	0	1	0	2	1	0	0
19	0	0	0	5	0	0	3	0	1	0	1	1	0	1	1
20	1	0	0	0	5	0	1	1	1	2	0	1	1	0	1
21	0	3	1	0	0	5	1	0	1	1	1	0	3	0	1
22	0	0	0	3	1	1	5	0	1	1	0	1	0	1	0
23	1	0	0	0	1	0	0	5	0	0	0	0	1	1	1
24	0	1	0	1	1	1	1	0	5	2	0	0	1	1	2
25	0	1	1	0	2	1	1	0	2	5	0	0	3	0	0
26	1	1	0	1	0	1	0	0	0	0	5	0	1	0	0
27	1	0	2	1	1	0	1	0	0	0	0	5	0	0	0
28	0	2	1	0	1	3	0	1	1	3	1	0	6	1	1
29	0	0	0	1	0	0	1	1	1	0	0	0	1	5	1
30	0	0	0	1	1	1	0	1	2	0	0	0	1	1	5

The Ucinet software procedure generates the following diagrams. Figure 2 represents a sociogram that is applied by multi-dimensional scaling of the network of connections between places and places. The number of each node is the place number that is indexed for analysis. Hence, this figure helps with the visual identification of the structure of social relations among community members and landmarks, as well as the key players within landmarks.

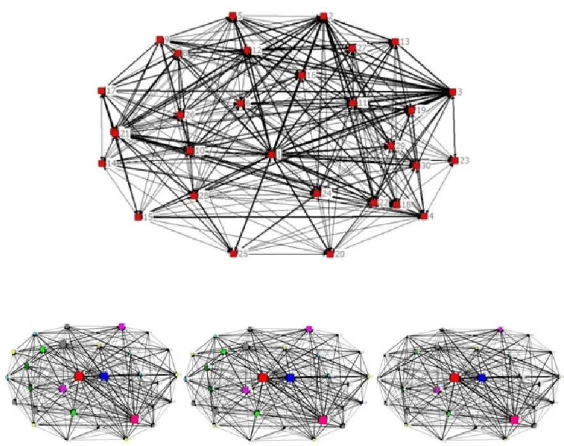

Figure 2 – Sociogram of two-mode network analysis from left to right: Eigenvector (Diversity), Degree (Activity), Betweenness (Control). (See Table 4.4 for the specific place name of each id)

Table 16 tabulates the top 5 landmarks for each measure. In this table, the measures of centrality were associated with their potential network impacts, activity, control, and diversity. Places at the top list, with the highest degree of centrality, were also the most well-known landmarks to most community members. Of course, this makes intuitive sense as the degree of centrality simply measures the total number of connections. It may be concluded that the rankings of degree centrality are, indeed, a factor of the familiarity of landmarks. Table 4.3 also shows the results order of each centrality.

Table 16: Centrality Measures of Five Most Familiar Places (See Table 1 for the Specific Place Name of Each Id)

PLACE ID	DEGREE (ACTIVITY)	BETWEENNESS (CONTROL)	EIGENVECTOR (DIVERSITY)
1	29	14.349	0.256
3	28	13.486	0.248
2	27	11.911	0.240
28	24	8.048	0.220
12	24	7.518	0.222

The top 5 list of places in degree centrality are 1, 3, 2, 12, and 28. The rank order of betweenness has changed significantly compared with degree centrality. Indeed, the high-ranking places are 1(14.349), 3(13.486), 2(11.911), 28(8.048), 12(7.518). Place 3 confirms the intermediary role. Looking at measures of the eigenvector centrality measures, the top 5 list of places are similar with degree centrality. It can be concluded that place 1(0.256), 3(0.248) and 2(0.240) have the highest measures. Across the three kinds of measures in centrality, places 1, 3, 2, 28 and 12 stand out as the most central ones. Considering the overall central measures of all mentioned results, the Wetex Complex Mall (see Figure 3), river front and clock tower, and Jalan Maharani and the Legenda shopping complexes, are the most centrally located to this community. The study focused on determining how regional places might be recognized according to their social communication.

Figure 3 – Wetex and Caltex Station in Jalan Sulaiman [20]

The substantive finding of these specific experiments is that the places are categorized according to their social community. Some places were meaningful landmarks to the members of local community, but not to others. Most of the well-known places are functional places, which are tightly related to the common interest of a community.

Lastly, the social network analysis revealed the central locations of community and the structural characteristic that was embedded in mental image of a social group. The river front was a natural landmark that was used very frequently to explain a location. In fact, when answering questions about the ten best places, the Wetex and Legenda shopping places and Jalan Maharani were noted as communicational places for users to hold meetings as well as for other gathering purposes.

4.2 Formal Method

The formal method of analysis has been applied in this paper. The attractiveness measurement is implemented for the eight most popular landmarks in Muar (e.g. bus station, clock tower, court building, Hotel D'99, Masjid Sultan Ibrahim, river front, Trader's Hotel and Wetex Shopping Parade). In addition, to make a comparison analysis between methods mentioned in this study, these landmarks are collected from the places mentioned in Table 1 and Table 17. The following discussion introduces the best landmarks according to the results of the formal method ranging from the most to the least.

Table 17: Total Value for Landmark Saliency Measurement

Number of places	1	2	3	4	5	6	7	8
Places ID	3	2	20	24	26	1	8	23
Visual attraction value	0.4	0.2	0.6	1	0.8	0.8	0.2	0.2
Semantic attraction value	1	1	1	0.5	0.5	0.5	0.5	0.5
Structural attraction value	0.5	0.5	0	0	0	0	0.5	0
Total Value	1.9	1.7	1.6	1.5	1.3	1.3	1.2	0.7

Landmarks have distinctive features and make it easy to find destinations. The function of landmarks is also the most important factor to make them more memorable. According to the aforementioned method, it is necessary to evaluate the effective elements of landmarks. For this aim, the method of Raubal and Stephan Winter [10] was applied. The result demonstrated the quality of the components of each chosen landmark and also the identification of the most attractive landmarks in the town. In sum, the results show that the most attractive landmarks in the town, ranging from the most to least are: river front (see Figure 3), clock tower, Masjid Sultan Ibrahim, Trader's Hotel, Hotel D'99 and Wetex shopping mall, bus station and the Muar court building. The current result helps this study to make a comparison between the two methods.

Figure 3 – River Front Located in MUAR Town [20]

5. Discussion

Based on the results from each method, there is a disparity between the results from social network analysis and the results from formal method. As mentioned, the most distinctive landmarks in social network analysis, from the most to least, were: Wetex shopping mall (Degree: 29, Betweenness: 14.349, Eigenvector: 0.256), river front (Degree: 28, Betweenness: 13.486, Eigenvector: 0.248), clock tower (Degree: 27, Betweenness: 11.911, Eigenvector: 0.240), Jalan Maharani (Degree: 24, Betweenness: 8.048, Eigenvector: 0.220). On the other hand the most distinctive landmarks according to the formal method were: river front (total value: 1.9), clock tower (total value: 1.7), Masjid Sultan Ibrahim (total value: 1.6), Trader's Hotel (total value: 1.5), Hotel D'99 and Wetex shopping mall (total value: 1.3), bus station (total value: 1.2) and Muar court building (total value: 0.7). Based on social network analysis, the Wetex shopping mall was identified as first, although the riverfront is the first mentioned landmark in the formal method. Moreover, the Wetex shopping mall, which is the best landmark in social network analysis, was indicated as the fourth landmark in the formal method. After getting all datasets, this study aims to find the reason for these differences and find ways to optimize the formal method. It can be concluded that the role of orientation for creating the landmarks in the town of Muar was found to be strongly shaped by the functional, emotional and socio-cultural attributes of landmarks. The functional significance of the places can be related to the importance of the landmarks in addressing the individual's goals and requirements as well as providing conditions that assist way-finding. According to the results from the social network analysis, most of the best identified landmarks are places that people can get together, and places which also accommodate social activities. Regarding the Wetex shopping mall, the riverfront is a good place for use as a recreational landmark and Jalan Maharani, which consists of many stalls, is the most crowded street in town; it seems that places which have the functional potential of a meeting place are more memorable than others. Therefore, it is obvious that the current formal method needs to be optimized by adding other factor as a communicational value for evaluating landmarks saliency. Based on the three notable parts in the formal method, the next step is to find an appropriate part between the mentioned parts that relate to people communicational activities. In addition, it is clear that it is necessary to add communicational value as a factor to the second part of the formal method (semantic attraction: cultural and historical value and explicit mark). It predicts that by applying communicational value as one of the existing coefficients, the disparity between the two methods that have been discussed here will be decreased. To calculate the communicational value, it is necessary to estimate the value of each place as a communicational landmark by categorizing the landmarks function. From the case study [20] and the survey analysis (people were asked to mark the most interested places based on their function from the most to the least), it is concluded that restaurants and other places related to food, shopping and places which involves a large number of stalls are popular places for residents of Muar to engage in communicational activities. So based on the response of the people, the communicational places are categorized and estimated. The communicational value is calculated by assigning the Boolean value to each object (if an object consists of communicational value, T for "True" or T and F for "False"). The classified types of places' functions, which are 4 for restaurants, 3 for shopping centers, 2 for recreational areas and 1 for public spaces, can be used to weigh the communicational value of each landmark. Table 18 indicates the suggested communicational value measurement.

Table 18: Communicational Value in Structural Attraction and How It Is Measured

Properties For Semantic Attraction	Measurement
Communicational value	£ ϵ {T, F} £ ϵ {1, 2, 3, 4} Scale Of Importance: 1(High) – 4(Low)

6. Conclusion

Through the analysis, findings and discussion, there are several main factors to be considered when designing and planning landmarks in urban environments. This study examines two methods. The first one helped the study to get close enough to the most distinctive landmarks based on demographic information. By applying social network analysis, and then by applying the formal method, it becomes possible to obtain straight and accurate results about the amount of activity in each place. According to the demographic results from the first part of analysis which consider people ideas, it could be hypothesized that the social network analysis result can serve as a fundamental reference. This study attempted to obtain results from the second part of the analysis (formal method) closer to the results from the first part of the analysis. As discussed, some factors, such as communicational factor or age and gender differences, are not involved in the current formal method. This study tries to optimize the formal method by adding communicational value. For future studies, it is necessary to consider gender and age value as factors which can affect landmark saliency in the formal method.

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