

# Designating Preference Starting Point of Heritage Trail within Heritage City of Parakan, Central Java, Indonesia Using Fuzzy Logic Approach

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**Abstract:** *This research is a part of multi-year research, which was started last year by conducting some studies, either literature or simulation, for the fuzzy logic approach used as a decision maker. In supporting the primary research of designing a heritage trail within a heritage city, particularly the heritage city of Parakan, Central Java, Indonesia, this research was also delivering the analysis of preferences through the community to designate the appropriate and preferred starting point for the trail within the historical area of the Heritage City of Parakan. By using fuzzy logic, this research has analyzed the relevant starting point of the trail within the historical area of a Heritage City of Parakan. It has been proposed, together with another study result, to be a good design. Thus, this research has completed some of the basic principles of the fuzzy logic approach to decide the appropriate and preferred starting point of the trail within the historical area of Parakan.*

**Keywords:** *heritage trail, fuzzy logic, Parakan, heritage city, starting point, decision maker*

## 1. Introduction

Purwantiasning, in previous research, has explained that the city of Parakan is well known among its society for its history as the pioneer of Bamboo Runcing, also known as Kyai Bamboo Runcing. KH Subuki introduced Bamboo Runcing as a traditional weapon one hundred years ago. The city also has many colonial buildings that should be preserved because of their history. Some historical buildings remain intact, but some are in ruins due to lack of maintenance. They are located in and include Old Station, Klenteng Hok Teng Tong, Pasar Legi, Chinatown, Candi Setapan, Gunung Candi, Kali Galeh Old Bridge, PT KAI Residence Kadewanan (Government Office), KH Subuki's house, KH Subuki's Cemetery, Langgar Wali (Wali Mosque), the Kauman Area, and Masjid Al Barokah Bambu Runcing (Bamboo Runcing mosque). One aspect that gives Parakan a unique architectural character is the existence of Chinese houses within the Chinatown area. The physical condition and the visual image of these buildings have remained the same; they are still original and are about two centuries old [1].

Histic and Nebojsa [2] have underlined strategies of conservation and development based on a clear perception of the existing potential and their rich use in the future. The active protection of the urban unit and dynamic rehabilitation involves integrating heritage into contemporary life trends by emphasizing the identity of space. Thus, the activity of conservation and preservation needs to be conducted as significantly as it is, depending on the understanding of cultural heritage and the community's willingness to conserve and preserve [3].

A discussion about conservation and preservation has related to the history of heritage buildings also historical sites. As mentioned in previous research, Purwantiasning [4] has explained that the word history is also related to

old-times events such as memory, findings, collections, organization, presentation, and interpretation of specific information about particular events. History could be connected to academic research, which uses a descriptive narrative method in delivering and analyzing an event chronologically and objectively can find the pattern of cause and effect of a particular event in the past. Lowenthal [5] also mentioned that, for some reason, history could be related to the culture of the community as well as to the place which is related to the legend and cultural heritage.

Mutiawati and Ikaputra [6] have stated that historical buildings in various cities in Indonesia are essential assets that need to be preserved and have the potential to be developed. The importance of maintaining these historic assets gave rise to a concept. One method to maintain the historic assets is by delivering a heritage walk or trail within a historical site, particularly in Indonesia, which has many historical sites. According to the heritage trail's guidelines [7], the activity of heritage trails is an increasingly popular means of promoting an area's heritage. This statement has been strongly supported by Kumar [8] with his previous research about promoting Delhi as an ancient city. Kumar said that Delhi, with multiple layers of built heritage and living tradition, offers tourists a unique heritage walk experience.

Moreover, heritage trails can be interpreted as: "... established routes linking significant items of an area's heritage. They are usually promoted in tourist pamphlets and are often supplemented by interpretive pamphlets or cassette tapes. Some trails incorporate plaques or signs on structures to provide additional information" [7]. Meanwhile, Timothy [9] in Patria [10] provides another understanding of heritage trails, where heritage trails are defined as: "In all cases, the primary physical characteristic of heritage trails is their linear and nodal properties. In most cases, they are a composition of specific individual attractions connected by walking, cycling, or driving routes."

In designing a good heritage trail, it should refer to the guidelines, and one of the steps is to designate an appropriate meeting point to start the trail activity. This research proposes an appropriate meeting point within the historical site of Parakan as a part of the implementation of the heritage trail or heritage walk activity. This research has undertaken a fuzzy logic method to make a reliable decision about the preferred meeting point.

In their previous research, Lazuardi and Prasetyo [11] stated that the fuzzy logic method expert system is effectively used to draw conclusions from several problems with varying variables. And has been supported by the statement of Sofwan [12]; fuzzy logic is one of the control system methods that can provide decisions that resemble human decisions. Many previous researches have been carried out by using a fuzzy logic method as a tool to be the decision-maker. For example, Santos et al. [13] have completed their research by using fuzzy logic to help select optimal and sustainable life cycle maintenance and rehabilitation strategies for road pavements. A similar research by Stetter [14] also mentioned that fuzzy logic is very helpful for decision-making in virtual actuators in accommodating several possible faults, such as a slippery surface under one of the drive modules of Automatic Guided Vehicles. Another research referring to the fuzzy logic method, also mentioned by Liu et al. [15], described how to make an exit selection behavior of pedestrians because it has been mentioned that this decision-making plays an essential part in the evacuation process. Those three examples of research that used fuzzy logic to make decisions have shown that this fuzzy logic could be implemented in any field. In the research of Daradkeh and Tvoroshenko [16], a fuzzy logic method has been regarded as a technology that could be used for making reliable decisions on a variety of needs.

## **2. Research Method**

To obtain a practical location selection for the main meeting point for the activity of heritage walk within the historical site of Parakan, this research has been completed by using a simulation based on fuzzy logic as a decision making. This simulation system has been undertaken by using a MATLAB program. Some Points of Interest (POI) have been designated in this research (nineteen POI). Each data of POI has been described in Table 1. Based on those data, a decision-making system has been formulated with some variables and fuzzy sets used in this research

(see Table 2); they are distance, number of visitors, connectivity, and open space. From the data in Table 1, moreover, the designated system has been imported with data input to see which POI has a high recommendation. Thus, the highest recommendation of POI has been decided as a main meeting point for the activity of the heritage walk within the historical site of Parakan. And this main meeting point should be integrated with all the trails within the historical site of Parakan.

TABLE I: List of Point of Interest (POI) within Heritage City of Parakan

No.	Point Of Interest Locations	Distance (M)	Number Of Visitors/Day (Person)	Connectivity (Unit)	Open Space (M <sup>2</sup> )
1.	Pasar Legi	900m	1000	5	50M <sup>2</sup>
2.	Masjid Al Baraqah/Masjid Bamboo runding	650m	200	4	1000M <sup>2</sup>
3.	Langgar Wali	870m	100	4	3000M <sup>2</sup>
4.	Makam KH.Subuki	650m	100	3	2000M <sup>2</sup>
5.	Rumah KH.Subuki	700m	100	4	750M <sup>2</sup>
6.	Makam KH.Parak	650m	100	3	1500M <sup>2</sup>
7.	BMT Parakan	600m	0	3	2500M <sup>2</sup>
8.	Kawedanan	110m	200	3	2500M <sup>2</sup>
9.	Stasiun KA.Parakan	450m	200	5	1000M <sup>2</sup>
10.	Koridoor Kampung Kauman	1300 m	500	2	0
11.	Klenteng Hok Tek Tong	200m	500	4	500M <sup>2</sup>
12.	Rumah Marga Siek/Rumah Gambiran	500m	200	4	200M <sup>2</sup>
13.	Rumah Gotong Royong/Low Djing Tai	500m	200	4	200M <sup>2</sup>
14.	Rumah Marga Tjiong dan Jalan Gambiran	350m	200	3	150M <sup>2</sup>
15.	Omah Abu Tan Liang Hoo	250m	200	4	750M <sup>2</sup>
16.	Perumahan PT.KAI	500m	100	4	2500M <sup>2</sup>
17.	Jembatan Rel Kereta Api Parakan	350m	100	3	500M <sup>2</sup>
18.	Rumah Dinas Controleur	1100m	200	4	2000M <sup>2</sup>
19.	Jembatan Kali Galeh	130m	100	5	100M <sup>2</sup>

Determining the main meeting point for the heritage walk within the historical site of Parakan has been simulated using a decision-making system based on Fuzzy Logic. This system simulation is done in MATLAB programming. The variables and fuzzy sets used are given in Table 2.

TABLE II: Variables of fuzzy and fuzzy sets

Items	Variables of Fuzzy				
	Input				Output
	Distance (m)	Number of Visitors (persons)	Connectivity (modes)	Open Space (m <sup>2</sup> )	Reccomendation (%)
Fuzzy Sets	Close Distance (<200)	Few (<100)	Few (<2)	Small (<200)	Low (<20)
	Medium Distance (200-1000)	Moderate (100-1800)	Moderate (2-4)	Moderate (200-2800)	Moderate (20-80)
	Long Distance (>1000)	Many (>1800)	Many (>4)	Large (>2800)	High (>80)

### 3. Result and Discussion

The main concept of heritage trails is linking important items of an area's heritage from one heritage building to another. This route needs a main place as a starting point which is known as a meeting point. The meeting point is regarded as a place to gather before the activity of the trail begins. The term "main place" should be related to distance, connectivity, and large open space.

Table 1 describes the data of each Point of Interest (POI) that have been used as input variables of fuzzy logic: the distance, the number of visitors, the connectivity, and the availability of open space. The distance has been calculated from the main point called Tugu Parakan (the landmark of the Main Entrance to the Heritage City of Parakan). The number of visitors of the POI has been adopted from the monthly report of the statistic of the District Office of Parakan. The connectivity has been calculated from the number of available public transportation within the surrounding POI. The last used variable as a fuzzy logic input variable is the availability of open space within surrounded POI, either inner or outer open space. ‘

The fuzzy logic system has been designed to determine the location of the main meeting point is given in Figure 1. The Mamdani type of Fuzzy Inference System (FIS) fuzzy logic system was used with four input variables (Distance, Number of Visitors, Connectivity, and Open Space) and one output variable (recommendation), as given in Table 1.

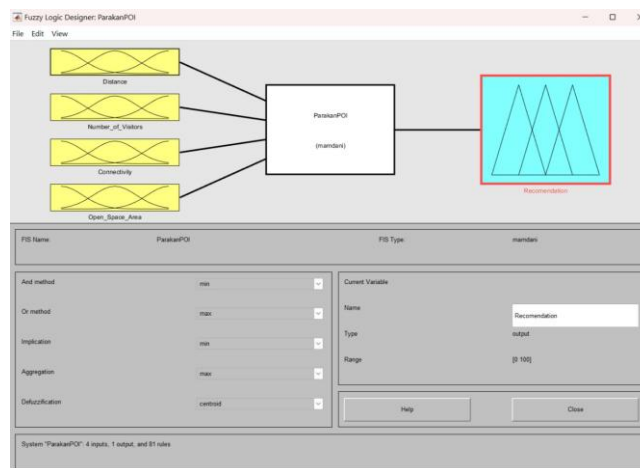


Fig. 1: Fuzzy logic decision making design.

On the other hand, the Membership Function of each fuzzy variable and fuzzy set for either input or output variables have been shown in Figure 2 and Figure 3, respectively.

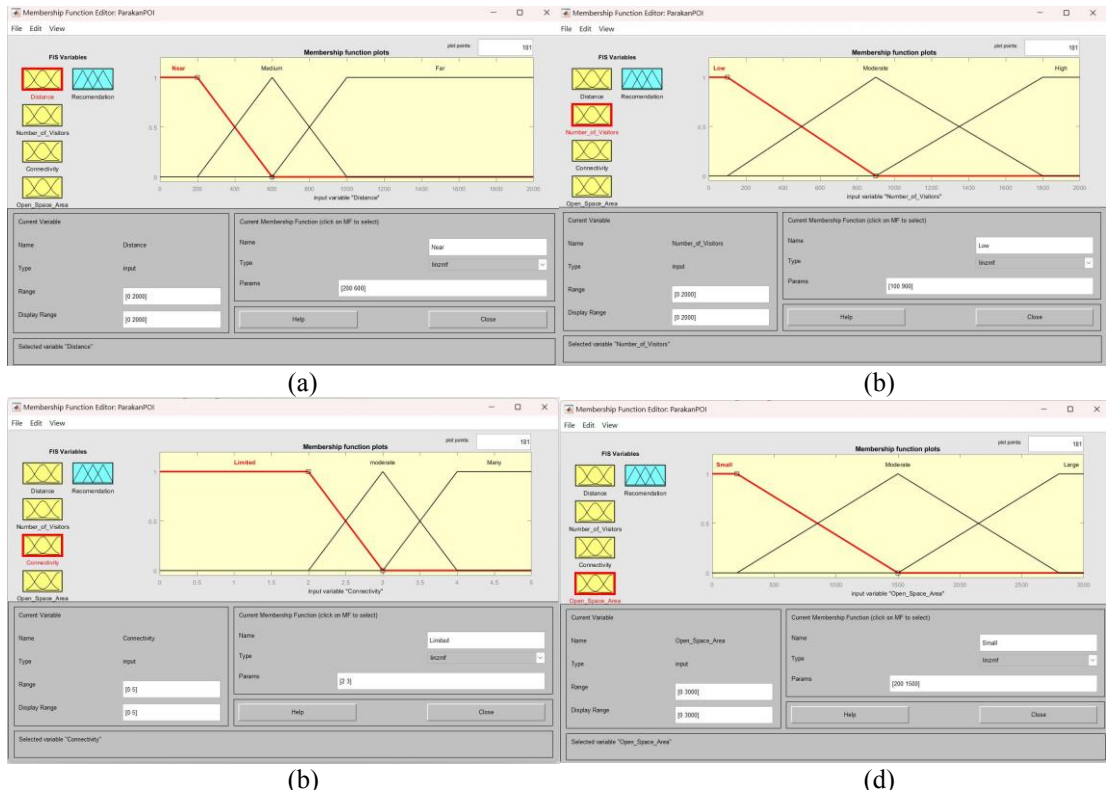


Fig. 2: Fuzzy Sets of input variables and its membership function: (a) the distance, (b) the number of visitors, (c) the connectivity and (d) the open space

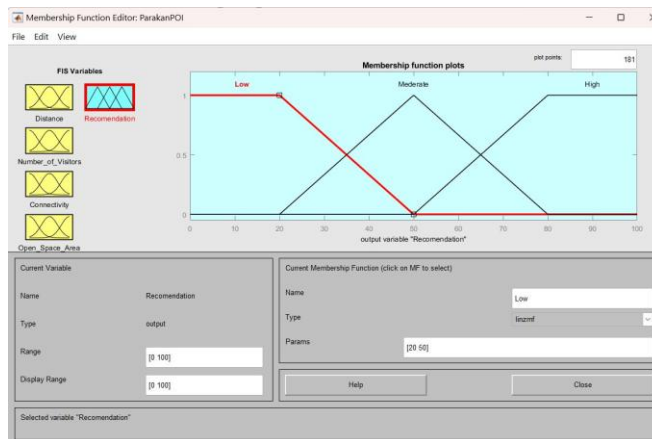


Fig. 3: Fuzzy sets and its membership functions of recommendation

Based on the number of fuzzy input variables, there are four fuzzy variables that fuzzy sets have used. Each number is three. Therefore, this fuzzy system has used eighty-one fuzzy rules, as shown in Figure 4.

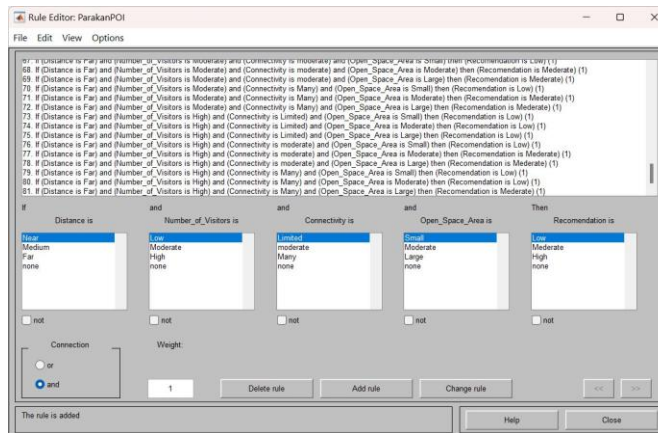


Fig. 4: Fuzzy rules

The result of the analysis using fuzzy variables and fuzzy sets has been concluded as described in Table 3 as follows:

TABLE III: Fuzzy variables and fuzzy set result

No.	Point Of Interest Locations	Distance (M)	Number Of Visitors/Day (Person)	Connectivity (Unit)	Open Space (M <sup>2</sup> )	Recommendation (%)
1.	Pasar Legi	900m	1000	5	50M <sup>2</sup>	19,7
2.	Masjid Al Baraqah/Masjid Bamboo runcing	650m	200	4	1000M <sup>2</sup>	39,5
3.	Langgar Wali	870m	100	4	3000M <sup>2</sup>	50
4.	Makam KH.Subuki	650m	100	3	2000M <sup>2</sup>	32,6
5.	Rumah KH.Subuki	700m	100	4	750M <sup>2</sup>	33,8
6.	Makam KH.Parak	650m	100	3	1500M <sup>2</sup>	19,0
7.	BMT Parakan	600m	0	3	2500M <sup>2</sup>	43,7
<b>8.</b>	<b>Kawedanan</b>	<b>110m</b>	<b>200</b>	<b>3</b>	<b>2500M<sup>2</sup></b>	<b>72,6</b>
9.	Stasiun KA.Parakan	450m	200	5	1000M <sup>2</sup>	43,1
10.	Koridor Kampung Kauman	1300 m	500	2	0	21,2
<b>11.</b>	<b>Klenteng Hok Tek Tong</b>	<b>200m</b>	<b>500</b>	<b>4</b>	<b>500M<sup>2</sup></b>	<b>57,6</b>
12.	Rumah Marga Siek/Rumah Gambiran	500m	200	4	200M <sup>2</sup>	28,1
13.	Rumah Gotong Royong/Low Djing Tai	500m	200	4	200M <sup>2</sup>	28,1
14.	Rumah Marga Tjiong dan Jalan Gambiran	350m	200	3	150M <sup>2</sup>	25,9
15.	Omah Abu Tan Liang Hoo	250m	200	4	750M <sup>2</sup>	50
<b>16.</b>	<b>Perumahan PT.KAI</b>	<b>500m</b>	<b>100</b>	<b>4</b>	<b>2500M<sup>2</sup></b>	<b>43,7</b>
17.	Jembatan Rel Kereta Api Parakan	350m	100	3	500M <sup>2</sup>	29,1
18.	Rumah Dinas Controleur	1100m	200	4	2000M <sup>2</sup>	32,6
19.	Jembatan Kali Galeh	130m	100	5	100M <sup>2</sup>	50

Table 3 shows that the highest recommendation value is the Kawedanan Point, and the lowest recommendation value is Makam KH Parak Point. Kawedanan Point has the shortest distance from Tugu Parakan and has a relatively large open space. From Table 3, it has been recommended that Kawedanan Point become the most significant and feasible point for the main meeting point to start the activity of the heritage trail within the Heritage City of Parakan.

## 4. Conclusion

To conclude this research, the authors have stated that there are three recommendations with moderate levels (20-80 %). They are Kawedanan with 72,6 %, Klenteng Hok Tek Tong with 57,6 %, and Perumahan PT KAI with 43,7 %. But from those three recommendations, Kawedanan is the highest recommendation with 72,6 %; also, this building has a large open space for meeting points. The two others are the Temple of Klenteng Hok Tek Tong which is impossible to have many people in the open space because it will disturb religious activities, and Perumahan PT KAI is a residential area, which is impossible as well to have many people nearby the place because it will disturb the activity of the resident.

As a result, we have recommended Kawedanan as an appropriate meeting point for the activity of the heritage walk within the historical site of Parakan. By delivering this recommendation, the implementation of the activity of the Heritage Walk within the Historical Site of Parakan could be applied appropriately.

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