Determination of the Suitability of the Traditional House Atmospheric Environment Using the Simple Additive Weighting Method as a Digital Architecture Model

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Abstract. Magelang is a city that has many cultures, one of which is the Rumah Kampung which is a traditional house of Central Java. One of the important things in the construction of a village house is the atmosphere. Architects have an important role in creating quality architectural works in order to gain an understanding of the traditional architecture of the Rumah Kampung. The lack of information related to the past environmental conditions of a traditional building, thus causing the redesign of the building model there are differences. The purpose of this study is to build a decision support system to assist architects in analyzing the suitability of traditional buildings in the modification of a traditional building in order to obtain a detailed understanding of the architectural environment of traditional houses. The development of a system for determining the suitability of the environmental atmosphere for traditional houses applies the Simple Additive Weighting (SAW) method. The SAW method is used because this method is considered valid to determine the suitability of the atmosphere of the village house which can be used as an analytical tool for a cultural architect. The research begins with a literary review, collecting data on the atmosphere of traditional houses in the Borobudur temple area, analyzing system requirements, system design, implementation, and system testing. Based on testing of the system for determining the suitability of the traditional home atmosphere environment with the Expert Judgment method, the best alternative was obtained, namely the building with 90% results. The results of the system test using the Black Box test showed good functionality, while the usability test using the SUS method was carried out to get a score of 75.3 so it can be concluded based on the score that it is in the GOOD category with grade scale C which indicates the usability application is feasible to use or can be used. received.

Keywords: Atmospheric Environment, Traditional House, Simple Additive Weight, Digital Architecture

INTRODUCTION

Magelang is a city that has many cultures, one of which is Rumah Kampung. Rumah Kampung is a traditional house in Central Java that is used as a place to live. The Rumah Kampung in Borobudur still maintains the existing customs. One of the important things in the construction of the Rumah Kampung is the atmosphere (atmosphere) located in the area (S. P. N. Primadewi, 2019). The environment is the main characteristic of the atmosphere in the context of architecture. In the world of architecture, when developing a traditional building, minimal information is often obtained regarding traditional buildings, such as past environmental conditions around traditional buildings, road conditions, beauty and distance between buildings and building models around the traditional house. Therefore, it is necessary to document knowledge related to the atmospheric environment for traditional buildings with the aim of maintaining or providing an atmosphere like the past. With the lack of information related to the past environmental conditions of a traditional building, resulting in the redesign of the building model there are differences, for example an inappropriate building philosophy, a size that does not match the period of the building at that time, or the typology model of the building. This study aims to obtain a complete understanding of the environmental atmosphere for the architecture of a traditional house, namely the Rumah Kampung in Borobudur. Therefore, a Decision Support System is needed. DSS itself is an interactive computer system that can use data to help make decisions in solving problems (A. A. Fauzi, H. Z. Zahro, & R. P. Prasetya, 2020). SAW is included in the Multiple Attribute Decision Making (MADM) problem solving technique. The concept of SAW is to find the sum of the weights through the rating of each alternative for each attribute (W. A. Pangestu, R. Renaldo, & N. Y. Sari, 2016). MADM is a technique that can be applied to choose the optimal alternative if it is seen that there are many alternatives to certain criteria (T. R. Adianto, Z. Arifin, & D. M. Khairina, 2017).

Research on the SAW method in decision support systems is nothing new. Several similar studies have been conducted by previous researchers. Muhammad Mardhenie (M. Muhammad, N. Safriadi, & N. Prihartini, 2017) conducted this research because road infrastructure improvements are still limited, such as the number of traffic lanes that need to be repaired with limited funds from the central government so that not all traffic lanes can be handled At the same time, the Public Works Department of Bina Marga Kubu Raya has difficulty in determining the priority of traffic lanes that must be repaired first based on priority criteria, thus a decision support system application is made to ensure priority of traffic lane repairs in the Kubu Raya Regency using a simple method. additive weights. Rita Novita Sari (R. N. Sari & R. S. Hayati, 2019). Doing this research because of the many choices of boarding houses on search engines so that someone is confused in choosing a boarding house in the city of Medan. To overcome these problems, a system is made that can help someone in choosing a boarding house according to the desired criteria using the SAW method. Tomy Reza Adianto [4] Conducted this research because of the increasing consumer demand in choosing a house to live in in the Samarinda area, thus making consumers to really determine the house based on the expected criteria. The design system was built to produce an application for determining residential housing using the SAW method. Febia Nurfitriani (F. Nurfitriani & F. Sembiring, 2021) Conducted research using the SAW method. This method was chosen because it is able to select alternatives from several alternatives based on predetermined criteria, namely in the form of cost, location, facilities and service quality. So that people can find out which hospital is appropriate to be a place for the healing process in their health. Ela Nurelasari (E. Nurelasari & E. Purwaningsih, 2021). Conducting this research aims to find out the best housing with predetermined criteria. Based on the results of the analysis using the SAW method, the highest value is produced, so that the decision to choose the best housing because it has the highest value. Therefore, the decision support system developed using the SAW method can assist in making the best housing decisions with faster and more accurate calculation results so that the resulting information can be used as decision support.

Based on the description above to build a Decision Support System to determine the suitability of the Rumah Kampung atmospheric environment, the SAW method was chosen because this method is a technique that is considered capable of being applied in determining the suitability of the Rumah Kampung atmospheric environment which can be used as an analytical tool for a cultural architect (E. S. Wiyono & Latipah , 2017). This method is used because it can define the weight value of each attribute, after that it runs a ranking process to choose the best alternative from several alternatives. With this ranking, it can be used to help make a more precise assessment based on the assessment of the criteria and weights that have been determined (M. Muhammad, N. Safriadi, & N. Prihartini, 2017). Using this method is expected to help in supporting the right decision analysis for a cultural architect. The following are several theories related to this research, namely decision support systems, Environmental Atmosphere and the SAW method.

Decision Support System (DSS) is an interactive computer-based system with the aim of making it easier for users to make decisions using data and models to solve an unstructured problem (V. Khuangnata, R. Alamsyah, & V. Wijaya, 2021). One of the reasons for using DSS in determining the atmosphere of a traditional home environment is because it is in accordance with the components of a decision support system consisting of: Data Management is a database that contains relevant data for various situations and is managed by Database Management System (DBMS) software, Model Management and management software. needed and the existence of Communication where users can communicate and give commands to the DSS through subsystems such as providing interface design (S. Lestari & C. T. Safari, 2018). Thus the decision model that characterizes the DSS can be applied to the case of determining the suitability of the atmosphere of the traditional home environment as a model for the application of digital architecture. The decision model with the SAW method is part of the MADM (Multiple Attribute Decision Making) method where this method is known as the weighted addition method (M. A. J. P. R, Haliq & C. Irawan, 2022). The basic concept of SAW is to find the weighted number of performance ratings for each alternative in each attribute.

SAW also requires a decision of the matrix normalization process (X) on a scale that can be compared with all alternative ratings (Rosmalina & F. Asysyifa, 2021). In the SAW method, the decision ensures the weight of each attribute. The number of alternatives by adding all the results of the multiplication between the rating (comparable on all attributes) and the weight of each attribute. The rating of each attribute must be dimensional, meaning that it has passed the matrix normalization process that has been done previously. The application of the SAW method is considered to be able to overcome problems in determining the atmospheric environment of traditional buildings because it has many criteria with weights that have been determined by digital architecture experts.

RESEARCH METHOD

In determining the Traditional Village House in accordance with the atmosphere of the surrounding environment, criteria, sub-criteria, and weight data are needed. Therefore, the researchers conducted interviews with expert architects in order to obtain data on criteria and sub-criteria and weights based on the level of importance. The data will be used as a reference for determining the best Village House in accordance with the environmental atmosphere. The data that has been obtained will be processed into a knowledge model for a decision support system in determining the atmospheric environment of the Kampung Traditional House building. Stages of research on the development of a system for determining the suitability of the environmental atmosphere for Traditional Village Houses in Borobudur. This stage aims to provide a general description of the sequence of processes implemented in the construction of a system for determining the suitability of the environmental atmosphere for Rumah Kampung in Borobudur using the SAW method. Figure 1 shows the stages of the research.

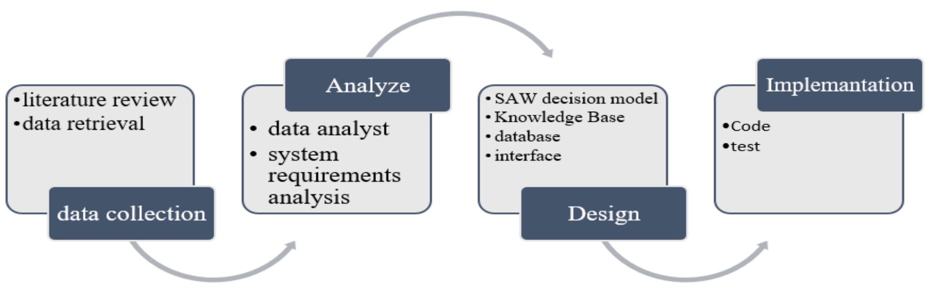

FIGURE 1. Research Stage

RESULTS AND DISCUSSION

1. Data collection

The data were obtained from interviews with expert architects so that the criteria data that would be used in building the system were obtained such as Table 1.

TABLE 1. Atmospheric Determinants of Environmental Criteria

Code	Criteria
C1	Building shape
C2	Building condition
C3	Fence shape
C4	Ambient temperature
C5	Distance between buildings
C6	The beauty around the building
C7	Road conditions
C8	Distance from fence to building

2. Data processing

Data processing criteria and sub-criteria along with the weights are determined based on the parameters that have been determined in the atmosphere of a traditional house which is then converted into alternative criteria, which are called sub-criteria.

3. SAW Decision Model

The SAW decision model begins with the input of the traditional building atmosphere environmental criteria, filling in the criteria weights with a value range of 0 to 4, then the value of each weight and the final alternative value will be calculated using equation (1) and equation (2) (D. Suprayogi & H. Mustafidah, 2021).

$$X = \begin{bmatrix} X_{11} & X_{12} & \dots & X_{1j} \\ X_{21} & X_{22} & \dots & X_{2j} \\ \vdots & \vdots & \dots & \vdots \\ X_{i1} & X_{i2} & \dots & X_{ij} \end{bmatrix} \quad \text{Notes: X = Value of each alternative, i = Alternative, j = Criteria} \tag{1}$$

Perform calculations of the normalized performance rating value (rij) from alternative (A) on the criteria (Ci) as in equation 2.

$$r_{ij} = \begin{cases} \frac{X_{ij}}{Max\ X_{ij}} & Benefit \\ \frac{Min\ X_{ij}}{X_{ij}} & Cost \end{cases} \tag{2}$$

Notes:

Xij =Attribute value of each criterion, Max Xij= the largest value of each criterion

Min Xij = the smallest value of each criterion

Benefit = Best greatest value

Cost = Best smallest value

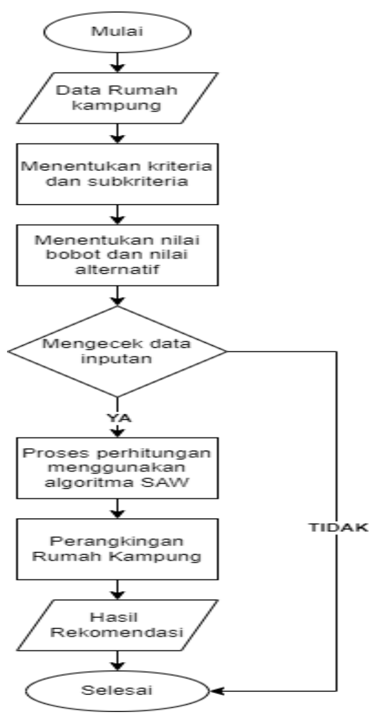

Figure 2. Decision Flow with SAW

After performing the normalization calculation, it produces a normalization matrix (R) like equation 3.

$$R = \begin{bmatrix} r_{11} & r_2 & \dots & r_{1j} \\ r_{21} & r_{22} & \dots & r_{2j} \\ \vdots & \vdots & \dots & \vdots \\ r_{i1} & r_{i2} & \dots & r_{ij} \end{bmatrix} \tag{3}$$

The final result (Vi) obtained from each ranking process is the sum of the normalized matrix multiplication (R) with the weight vector (W) so as to get the largest value as the best alternative (Ai), such as equation 4.

$$V_i = \sum_{j=1}^{n} W_j r_{ij} \tag{4}$$

Notes:
Vi = preference value
Wj = ranking weight
Rij = normalized performance rating
The value of Vi > indicates that the alternative (Ai) is selected.

Thus, from equation 1 to equation 4, the following results are obtained:

Table 3 presents the results of the suitability rating of each alternative for Rumah Kampung on each predetermined criteria. Furthermore, it is processed using the manual method to get the final value of determining the best Rumah Kampung atmosphere.

Table 3 The suitability rating of each alternative

Alternatif	**Kriteria**							
	C_1	**C_2**	**C_3**	**C_4**	**C_5**	**C_6**	**C_7**	**C_8**
A_1	3	3	2	2	3	4	1	2
A_2	2	1	3	2	2	3	2	3
A_3	3	3	4	1	3	2	3	4
A_4	1	1	4	2	3	4	3	4
A_5	3	1	1	1	1	4	2	3
A_6	3	3	2	2	1	2	1	2
A_7	2	3	3	2	2	3	1	3
A_8	2	2	4	1	3	1	3	1
A_9	1	2	4	1	1	2	2	2
A_{10}	2	3	2	2	3	1	3	3

The decision matrix is formed based on the suitability rating table as follows (a) and The normalized matrix (R) is obtained based on the following (b).

$$X = \begin{bmatrix} 3 & 3 & 2 & 2 & 3 & 4 & 1 & 2 \\ 2 & 1 & 3 & 2 & 2 & 3 & 2 & 3 \\ 3 & 3 & 4 & 1 & 3 & 2 & 3 & 4 \\ 1 & 1 & 4 & 2 & 3 & 4 & 3 & 4 \\ 3 & 1 & 1 & 1 & 1 & 4 & 2 & 3 \\ 3 & 3 & 2 & 2 & 1 & 2 & 1 & 2 \\ 2 & 3 & 3 & 2 & 2 & 3 & 1 & 3 \\ 2 & 2 & 4 & 1 & 3 & 1 & 3 & 1 \\ 1 & 2 & 4 & 1 & 1 & 2 & 2 & 2 \\ 2 & 3 & 2 & 2 & 3 & 1 & 3 & 3 \end{bmatrix}$$

(a)

$$R = \begin{bmatrix} 1.00 & 1.00 & 0.50 & 1.00 & 1.00 & 1.00 & 0.33 & 0.50 \\ 0.67 & 0.33 & 0.75 & 1.00 & 0.67 & 0.75 & 0.67 & 0.75 \\ 1.00 & 1.00 & 1.00 & 0.50 & 1.00 & 0.50 & 1.00 & 1.00 \\ 0.33 & 0.33 & 1.00 & 1.00 & 1.00 & 1.00 & 1.00 & 1.00 \\ 1.00 & 0.33 & 0.25 & 0.50 & 0.33 & 1.00 & 0.67 & 0.75 \\ 1.00 & 1.00 & 0.50 & 1.00 & 0.33 & 0.50 & 0.33 & 0.50 \\ 0.67 & 1.00 & 0.75 & 1.00 & 0.67 & 0.75 & 0.33 & 0.75 \\ 0.67 & 0.67 & 1.00 & 0.50 & 1.00 & 0.25 & 1.00 & 0.25 \\ 0.33 & 0.67 & 1.00 & 0.50 & 0.33 & 0.50 & 0.67 & 0.50 \\ 0.67 & 1.00 & 0.50 & 1.00 & 1.00 & 0.25 & 1.00 & 0.75 \end{bmatrix}$$

(b)

The ranking process is obtained based on preference weights according to the following in TABLE 4.

TABLE 4. The Calculation Result

Alternative	The Calculation Results	Rank
A_1	=(1x20)+(1x20)+(0.5x15)+(1x10)+(1x10)+(1x10)+(0.33x10)+(0.5x5)= 20+20+7.5+10+10+10+3.3+2.5 = 83.33	2
A_2	=(0.67x20)+(0.33x20)+(0.75x15)+(1x10)+(0.67x10)+(0.75x10)+(0.67x10)+(0.75x5)= 13.4+6.6+11.25+10+6.7+7.5+6.7+3.75 = 65.83	
A_3	=(1x20)+(1x20)+(1x15)+(0.5x10)+(1x10)+(0.5x10)+(1x10)+(1x5)= 20+20+15+5+10+5+10+5 = 90	1
A_4	=(0.33x20)+(0.33x20)+(1x15)+(1x10)+(1x10)+(1x10)+(1x10)+(1x5)= 6.6+6.6+15+10+10+10+10+5 = 73.33	5
A_5	=(1x20)+(0.33x20)+(0.25x15)+(0.5x10)+(0.33x10)+(1x10)+(0.67x10)+(0.75x5)= 20+6.6+3.75+5+3.3+10+6.7+3.75 = 59.17	
A_6	=(1x20)+(1x20)+(0.5x15)+(1x10)+(0.33x10)+(0.5x10)+(0.33x10)+(0.5x5)= 20+20+7.5+10+3.3+5+3.3+2.5 = 71.67	6
A_7	=(0.67x20)+(1x20)+(0.75x15)+(1x10)+(0.67x10)+(0.75x10)+(0.33x10)+(0.75x5)= 13.4+20+11.25+10+6.7+7.5+3.3+3.75 = 75.83	4
A_8	=(0.67x20)+(0.67x20)+(1x15)+(0.5x10)+(1x10)+(0.25x10)+(1x10)+(0.25x5)= 13.4+13.4+15+5+10+2.5+10+1.25 = 70.42	7
A_9	(0.33x20)+(0.67x20)+(1x15)+(0.5x10)+(0.33x10)+(0.5x10)+(0.67x10)+(0.5x5)= 6.6+13.4+15+5+3.3+5+6.7+2.5 = 57.5	10
	=(0.67x20)+(1x20)+(0.5x15)+(1x10)+(1x10)+(0.25x10)+(1x10)+(0.75x5)= 13.4+20+7.5+10+10+2.5+10+3.75 = 77.08	3

The ranking process is obtained based on the appropriate preference weights. After doing the calculations, the final results are obtained as in **TABLE 5**.

TABLE 5. Ranking

Alternative	Final Result	Rank
A_3	90.00	1
A_1	83.33	2
A_{10}	77.08	3
A_7	75.83	4
A_4	73.33	5
A_6	71.67	6
A_8	70.42	7
A_2	65.83	8
A_5	59.17	9
A_9	57.5	10

Based on Table 4, it can be concluded that the ranking results get alternative 3 results with a final result of 90 as the highest recommendation for the house with the best quality.

4. System Implementation

The results of the implementation of the system application for determining the suitability of the Rumah Kampung atmosphere in Borobudur using the SAW method. With the input shown in **FIGURE** 3.

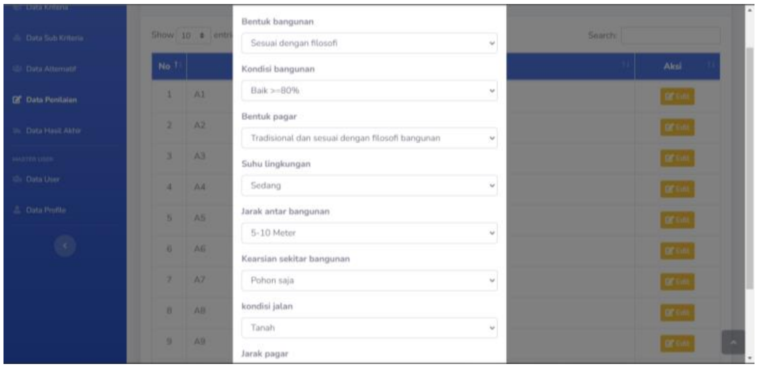

FIGURE 3. Rating page

Then the process carried out by the application of the system for determining the suitability of the Rumah Kampung atmosphere in Borobudur is to add up the multiplication of the normalized matrix row elements (R) with the preference weights (W) corresponding to the matrix column elements (W) such as equation 4. The final alternative value (vi) selected can be seen in Figure 4.

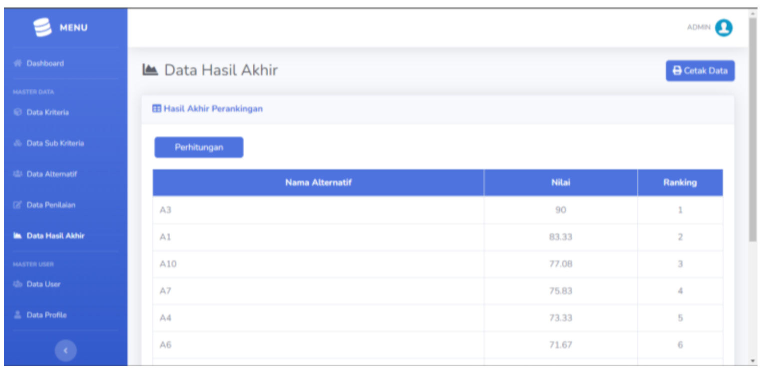

FIGURE 4. Ranking results

The largest value is found in A3 with a result of 90, A3 was chosen as the best alternative. The calculation process performed manually is the same as the calculation performed by the system.

5. System Test

System testing uses 3 methods, namely Expert Judgment, Black box test and System Usability Scale (SUS). The results of the Expert Judgment test showed that the results of calculations using the system were proven to be the same as the results of calculations carried out manually. Black Box testing in terms of functionality by using test scenarios so as to produce 100% of all system features feasible and successful. The results of the calculation of the score using the SUS method obtained a value of 75.3 so it was concluded that the score was in the GOOD category with a grade scale of C which indicates the usability application is feasible or acceptable.

CONCLUSION

Based on the research conducted, it resulted in the application of a decision support system for the suitability of the Rumah Kampung atmosphere in Borobudur which can be used as an analytical tool for a cultural architect. The SAW method can be applied in determining the suitability of the atmosphere of the Rumah Kampung in Borobudur. The results between manual calculations and the same system are A3 as the best alternative with a value of 90. Testing Black Box Test Functionally, the application has no syntax errors or errors. While the usability test using the SUS method gets a GOOD scale with a score of 75.3 then the application is declared feasible to use.

ACKNOWLEDGEMENTS

Thank you to the Central Java Architectural and Cultural Expert Team for facilitating the implementation of this research. Thank you also to all the research teams and research institutes at Universitas Ahmad Dahlan who helped to complete the research with the promised outcomes.

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Journal: AIP Conference Proceedings
Manuscript ID #: AIPCP23-AR-20215thICEAT-00071
Article Title: Image Classification with Support Vector Machine to identify Indonesian Traditional Building Types
Name: Sri Winiarti
Author(s): Sunardi Sunardi, Sri Winiarti, Ulaya Ahdiani, and Agung Parmono
Agreement Date: 31-Oct-2023 11:55 GMT

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