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Analysis Of the Health Decision-Making System for Elderly Hajj Pilgrimages in A Tour & Travel Company in Bandung Using the Simple Additive Weighting (SAW) Algorithm

Abstract

In Indonesia, the proportion of senior pilgrims performing the Hajj is rising annually, and by 2024, it will account for almost 30% of the total quota. In this case, particular consideration must be given to pilgrims' health readiness prior to departure. Inaccuracies, delayed information, and subjective decision-making may result from the manual health evaluation process used by a Bandung tour and travel agency for pilgrims. The purpose of this study is to use the Simple Additive Weighting (SAW) algorithm to develop a web-based decision support system and examine the decision-making process for the health of senior Hajj pilgrims. Rapid Application Development (RAD) is used in the system development process. Physical fitness, blood pressure, and blood glucose levels are among the health parameters that are used. The system's ability to objectively determine pilgrims' eligibility, rank them, and recommend testing results based on health categories (Accompanied, Unaccompanied, Recommended) demonstrates its objectivity. This solution reduces assessment errors, speeds up the evaluation process, and improves data management effectiveness.

Keywords: *Decision Support System, SAW, Elderly Hajj Pilgrims Health*

Introduction

The Hajj entails several physical rites that require the best possible physical preparation. More thorough health assessments are becoming increasingly necessary as Indonesia's older hajj pilgrim population grows. About 30% of all Hajj pilgrims are elderly, according to 2024 data from the Ministry of Religious Affairs. This increases the likelihood of health problems throughout the trip.

A precise, quantifiable, and impartial health evaluation procedure is necessary in this case prior to leave. Up until now, pilgrims' health evaluations have been conducted manually at a Bandung tour and travel agency, using direct observation and record-keeping. Because it takes longer, makes data presentation more difficult, and raises the possibility of subjectivity in decision-making, this approach is unproductive. Without an integrated system, health information is rarely documented, making it challenging for officials to assess pilgrims' eligibility for health care, especially the elderly.

A Decision Support System (DSS) is required to solve this problem by providing pilgrims with unbiased health recommendations. Simple Additive Weighting (SAW), a multi-criteria decision-making technique that enables weighting and evaluation based on multiple health parameters such as blood pressure, blood glucose levels, and physical fitness, is one approach that can be used. Because of its simple, unambiguous computations and simplicity of use in computer-based systems, the SAW method is used.

Elderly Hajj pilgrims' health

Elderly hajj pilgrims' health requires special consideration because they are more susceptible to conditions like diabetes, hypertension, and diminished physical stamina due to the constant physical demands of the hajj ceremonies. For pilgrims to fulfill their

religious responsibilities without severe physical discomfort, they must maintain good health. This is consistent with the perspective of Karina Nur Safitri and associates, who assert that health is a vital component that needs to be consistently maintained (Aditia et al., 2023).

Murti and colleagues define older adults as those aged 60 or older who inevitably experience social, mental, and physical decline as a result of aging (Rahayu & Nunu Nugraha P, 2024). This circumstance underscores the need for organized health evaluations for senior Hajj pilgrims.

System of Decision Support

In semi-structured situations, a Decision Support System (DSS) supports decision-making by analyzing data and applying analytical models to generate recommendations. Instead of taking the decision-maker's position, the DSS facilitates unbiased evaluation of options based on the information at hand (Anzani et al., 2024; Muharram et al., 2022; Putra & Soebroto, 2023). The Decision Support System helps officials systematically determine health eligibility during pilgrims' health examinations, leading to a more impartial and uniform assessment.

SAW (simple additive weighting)

In Multiple Attribute Decision Making (MADM), the Simple Additive Weighting (SAW) method uses criterion weights to identify the optimal option. Each criterion value is normalized before the weighted values of each alternative are added together in SAW (Budiyanto et al., 2020). According to Nugroho and Putra, SAW is helpful for ranking based on a set of pertinent evaluation criteria (Komariyah & Muslihudin, 2022). This approach was selected for the study because it yields accurate, clearly comprehensible data and has a simple computational methodology.

System of Health Information

To facilitate medical decision-making, a health information system integrates health data with information technology. By managing information such as pilgrims' medical histories, test results, and physical conditions, this system enables the timely, accurate, and organized conveyance of health information (Arsyah et al., 2021; Meri, 2020).

RAD stands for Rapid Application Development.

An approach to system development known as Rapid Application Development (RAD) emphasizes rapid prototyping and user involvement in the design process. Because the system must be modified iteratively to satisfy the demands of health officials, this approach is appropriate for our study (Ginting et al., 2020).

The purpose of this study was to apply the SAW algorithm to a web-based decision-support system and to examine the health assessment procedure for senior pilgrims. With this system in place, a Bandung tour and travel agency should be able to conduct pilgrims' health evaluations more rapidly, precisely, and methodically, ensuring that decisions are responsible and facilitate the successful completion of the hajj pilgrimage.

Research Method

This study was conducted at a Bandung tour and travel agency, with an emphasis on senior Hajj pilgrims undergoing health examinations prior to their departure. Rapid Application Development (RAD), which enables faster development through direct user iteration, is the system development methodology employed. Furthermore, the process of establishing health eligibility based on criterion weighting is supported by the Simple Additive Weighting (SAW) method.

There were various important phases in the research process. The study first identified issues with the elderly pilgrims' health evaluations, which were still conducted manually and subjectively. Data were gathered using a variety of techniques, including analyses of prior years' medical records, interviews with KBIHU Al-Hijaz health personnel, and observations of health evaluations for pilgrims performing the Hajj. The development of UML diagrams, including database design, use case, activity, and sequence diagrams, was the next step in the system design phase. Using the Rapid Application Development (RAD) methodology, a prototype was developed and subjected to numerous user tests and evaluations. To ensure that every function worked as intended, the system was lastly tested using Black-Box Testing techniques.

Metode Rapid Application Development (RAD), the RAD model consist of three main stages:

Table 1. Three Stages of RAD

Stage	Activity	Output
Planning	User needs analysis	System requirements document
Design Workshop	Interface design, process models and databases	System design & initial prototype
Implementation	Coding, feature integration & testing	The system is ready to use

Table 2. Simple Additive Weighting (SAW) Method

Code	Criteria	Type	Weigh
C1	Blood pressure	Benefit	0,40
C2	Blood Sugar Levels	Benefit	0,35
C3	Physical Fitness	Benefit	0,25

Normalization of Values, normalization is done using the formula:

$$R_{ij} = \frac{X_{ij}}{\max(X_i)}$$

Where:
Rij = Normalized criteria values
Xij = Initial value of criteria
Max (Xi) = Maximum value for each criterion

Final Grade Calculation
The final value is determined by:

$$V_j = \sum(W_i \cdot R_{ij})$$

Where:
Vj = Alternative final value
Wi = weight of each criterion

The calculation results are then ranked to determine the categories: Recommended, Unaccompanied and Accompanied.

Result and Discussion

The Rapid Application Development (RAD) approach is used to develop a web-based decision-support platform for evaluating the health of senior Hajj pilgrims. Managing pilgrim data, entering health criterion values, determining eligibility using the Simple Additive Weighting (SAW) approach, and displaying health suggestions as categories are only a few of the system's primary functions.

System Implementation, for health officials at a Bandung tour and travel agency, the technology presents an easy-to-use interface. Officials can enter the pilgrims' identity details and the findings of

their health assessments on the pilgrim data input page. The algorithm then computes weights using the SAW approach and normalizes the values to get final scores and eligibility rankings. The following kinds of health recommendations are then determined using the results of these calculations:

Category	Description
Recommended	The congregation is fit and able to perform worship
Without a companion	The congregation is in good health, but requires light monitoring
Mentoring	The congregation requires a special companion

Because the computation procedure is automated, there is less chance of human error, and the assessment is more consistent.

View of the designed system, Login Page, The administrator enters a username and password on the login page to access the system.

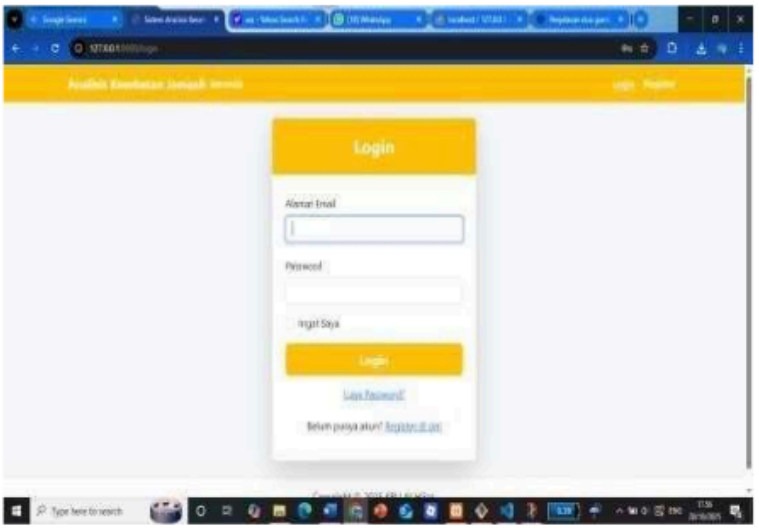

Figure 1. System Login Page

Dashboard Page, the dashboard shows the general system status, a navigation menu, and a summary of congregation data.

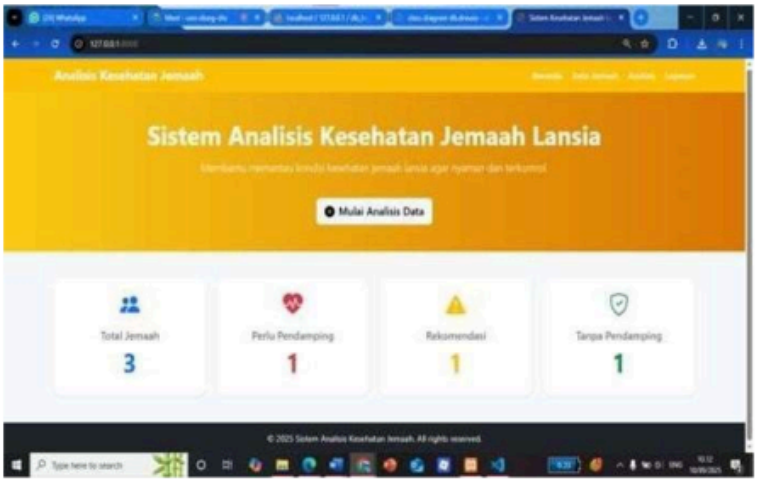

Figure 2. Dashboard Page View

Congregation Input and Data Page, congregation data can be entered, edited, and deleted using this page. SAW computations will be based on the saved data.



Figure 3. Congregation Input and Data Page

Congregation Health Value Analysis Page, on this tab, officers can enter the congregation's blood pressure, blood sugar, and physical fitness.

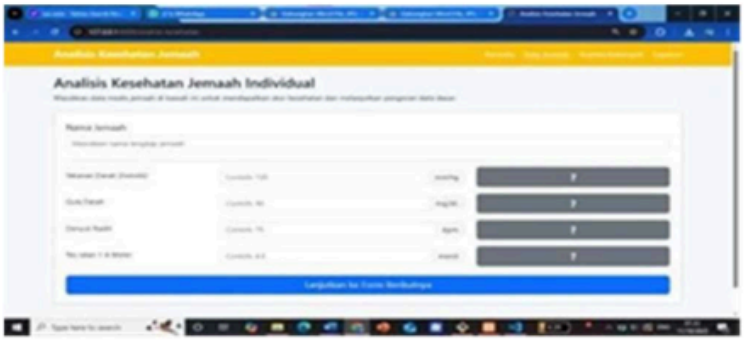

Figure 4. Health Value Input Form Display

Congregation Data Analysis Results Report Page, the findings of the congregation data analysis are shown on this page.

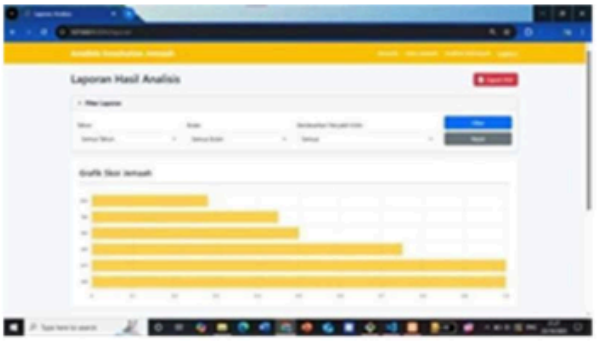

Figure 5. Print Report View

System Testing (Blackbox Testing), to ensure that all system functionality meets user expectations, testing was conducted using the Black-Box Testing approach. Table 1 displays the test results.

Table 3. Blackbox Testing Results

No.	Tested Functions	Scenario	Expected results	Status
1.	Admin login	Enter valid username and password	The system successfully logged into the dashboard	Succeed
2.	Input congregation data	Filling in and saving congregation data	Data is saved and displayed on the label	Succeed
3.	Edit congregation data	Changing data and storage	Data updated successfully	Succeed

4	Delete congregation data	Deleting data from a table	Data deleted from the system	Succeed
5	Input health values	Entering blood pressure, blood sugar, and fitness values	The value is saved and ready to be calculated.	Succeed
6	SAW calculation	The system performs automatic normalization and weighting.	The final value and ranking are displayed.	Succeed
7	Recommendation view	Displaying the calculation result categories	Categories are displayed according to their values	Succeed
8	Print report	Printing the evaluation results	Reports are printed according to the data	Succeed

Conclusion

Formalin chicken flesh denotes poultry that has been unlawfully preserved with formaldehyde (formalin). This approach is harmful to human health and violates food safety regulations (Khoiruddin & Tena, 2024). Non-formalin chicken meat features short fibers, a soft consistency, and extensive nutritional benefits, making digestion easier. The natural texture contrasts with that of formalin-treated chicken, which is more robust and abrasive due to chemical modifications. As a result, people prefer non-formalin beef for its enhanced quality and safety (Hestiningsih et al., 2023).

Image classification involves categorizing images into specific classes based on visual characteristics, such as color, texture, and shape. This approach is essential in image analysis as it enables

systems to independently recognize and differentiate objects (Velarati et al., 2024). Digital image processing aims to enhance image quality, facilitating interpretation by both people and machines. This method involves examining, improving, and modifying images to produce enhanced visual data for identification and classification (Kusumaningtyas et al., 2024).

A Convolutional Neural Network (CNN) is a deep learning methodology that replicates the functions of biological neural networks. CNN uses a feedforward architecture for classification and backpropagation for learning, enabling autonomous weight updates. The CNN architecture consists of two main phases: the feature extraction layer, which includes convolution and downsampling, and the fully connected layer, which includes flattening, hidden layers, and an output layer for producing final predictions (Banoth & Murthy, 2024).

MobileNetV2 is a convolutional neural network architecture designed to optimize accuracy and processing efficiency, rendering it appropriate for real-time applications on devices with limited specs. This architecture employs depthwise separable convolution, which differentiates spatial feature extraction using depthwise convolution and amalgamates inter-channel information via pointwise convolution (Nazuli et al., 2025). Android is a Linux-based operating system for mobile devices that includes the operating system, middleware, and various applications, aimed at enabling developers to create applications tailored to user needs (Fahrudin & Illah, 2023). TensorFlow Lite is a TensorFlow framework engineered to deploy complex models on Android, optimized for compactness and performance on mobile devices (Hussain et al., 2022).

References

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