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Application of the K-Nearest Neighbor Method in Web-Based Applications to Determine Early Childhood Development

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A B S T R A C T

Childhood is a period of rapid growth and development, so it is often termed as the golden period as well as the critical period. The golden period can be realized if at this time infants and children obtain suitable nutritional intake for optimal growth of flowers. But during this time Posyandu process is still done manually, so in providing the nutritional status information children must wait long. System that is able to assist in solving the problem is the Decision Support System (SPK) with the method K-Nearest Neighbor (KNN) that can produce information on the nutritional status of children that is the status of poor nutrition obtained from the calculation of weight /Age, very short status is obtained from the calculation of height/age, and very skinny status obtained from calculation of weight/height. And hopefully this system can be used in Posyandu to monitor the growth of children so that children with less nutritional status and poor nutrition get better and faster handling. The design of this decision support system uses a Web-based system with PHP programming language and a MySQL database for the web to be easily accessed.

## A R T I C L E   I N F O

1. INTRODUCTION

Adolescence is a period of very rapid growth and development. so that it is often termed a golden period as well as a critical period. The golden period can be realized if at this time infants and children receive appropriate nutritional intake for optimal growth and development [1-4]. According to data disclosed by the Director of Community Nutrition, the Ministry of Health, "The 2017 Nutrition Status Monitoring (PSG) results obtained 3.8% of children under five in Indonesia experiencing malnutrition. This **Figure 1.** increased from the previous year which was 3.4%. This shows that the problem of malnutrition needs to be handled more seriously. This PSG is an effort made by the government for planning, determining policies and monitoring and taking intervention actions in terms of improving toddler nutrition [5][6].
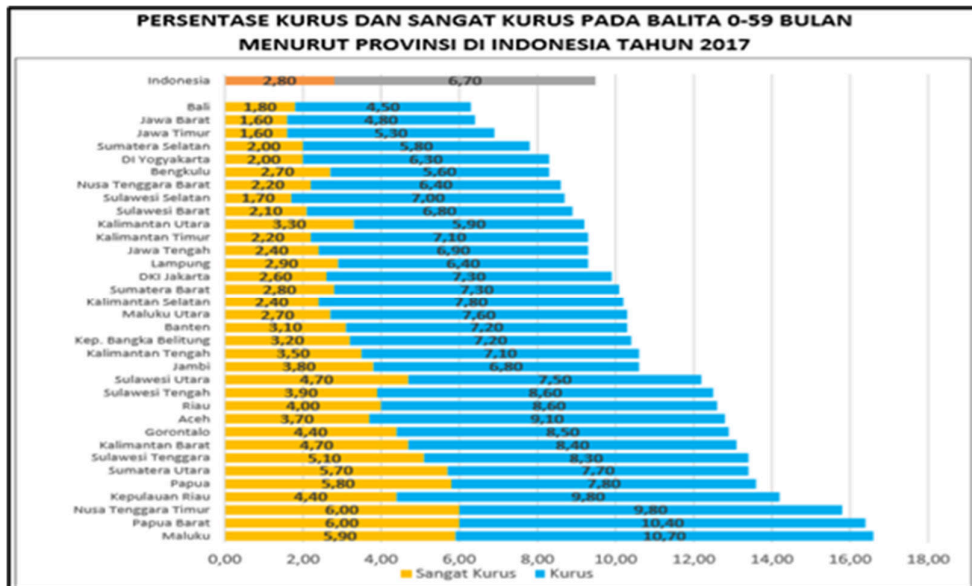
Figure 1. Graph of undernutrition and malnutrition in toddlers

The graph in **Figure 1.** shows cases of malnutrition and malnutrition by region in 2017. These cases occurred a lot in the East Nusa Tenggara region reaching 7.40 malnutrition and 20.90 malnutrition [7]. *Posyandu* is a form of community-based health effort (UKBM) that is managed and organized from, by, for and with the community in carrying out health development in order to empower the community and provide convenience to the community in obtaining basic/basic social health services to accelerate the reduction of mortality rates[8][9].

The people of Mangkalaya village - Sukabumi, in determining the nutritional status of toddlers are still manual, so that in providing information on the nutritional status of toddlers they have to wait a long time. In addition to the lack of control over the nutritional status of children, weighing data is also stored in a ledger, making it easier for data to be lost. The writer conducted this research using the K-Nearest Neighbor (KNN) method and compared several references such as K-Nearest Neighbor with Naïve Bayes and K-Nearest Neighbor with Backpropagation and K-Nearest Neighbor with Decision Trees[10-16].

From the results of the K-Nearest Neighbor with Naïve Bayes resulting in the results of classification of teak tree data from the forestry company, it was found that the K-Nearest Neighbor method has a higher level of accuracy, which is equal to 96.66%. Whereas for Naïve Bayes it is only 82.63% in terms of the accuracy of the results of the system and its calculations

[11]. While the comparison of K-Nearest Neighbor, if the classification can be done in a relatively faster time using the right algorithm is the K-Nearest Neighbor method, because using the K-Nearest Neighbor method with several training functions has an accuracy of 100%, whereas using the K-Nearest Neighbor method Backpropagation has a difference of 90% . And while the results of the K-Nearest Neighbor using the Decision Tree method produce an accuracy value of 98.18%, while the accuracy for the Decision Tree method is 96.06%. Therefore, to predict the nutritional status of toddlers, the K-Nearest Neighbor method is the best method [17-20].

From the comparison results above the K-Nearest Neighbor method in making decisions is much more accurate compared to other methods, and it is hoped that this research will provide a solution in determining the growth and development of early childhood from calculations with the K-Nearest Neighbor method according to existing criteria. This study provides an assessment of the growth and development of children at the *posyandu* starting from monitoring growth, nutrition and others, also helping the performance of *posyandu* cadres in calculating the nutritional status of children so that there are no delays in knowing the status of the child's growth and development.

2. METHODS

The research method is a scientific way to obtain data with a specific purpose. The scientific way means that research activities are based on scientific characteristics, namely rational, empirical, and systematic. From the definition above it can be concluded that the research method is a scientific way of obtaining data for certain uses.

2.1. Place and Research Object

The place of this research is the M.Toha *Posyandu* which is located in the village of Mkalaya – Sukabumi 43156, and the object of this research is the development and development of early childhood at the M.Toha Mkalaya *Posyandu*

2.2. Data Type

The study collected two types of data: quantitative data and qualitative data. Quantitative data was obtained from *Posyandu*, which included documents containing numerical information about children's data. These documents played a crucial role in supporting the research process related to child development. On the other hand, qualitative data was gathered through interviews conducted with relevant authorities or decision-makers involved in child growth and development. This data provided valuable insights into the current system used for calculating nutritional status.

2.3. Data Collection Stages

In this study, the researchers employed multiple approaches to gather comprehensive and reliable data. These approaches included literature study, interviews, and observation, each serving a unique purpose in data collection. The first method, literature study, involved an extensive review of relevant sources such as books, magazines, and online materials. This process allowed the researchers to acquire a solid theoretical foundation and gather information related to the research topic. Specifically, the literature study aimed to explore the K-Nearest Neighbor (K-NN) method and its applicability in the context of the study.

Moving on to the second method, interviews were conducted to obtain qualitative data. The researchers engaged in one-on-one interviews with individuals who possessed valuable

insights and expertise, such as the *Posyandu* cadres. By structuring the interviews around specific topics, such as performance, regulations, and monthly visit data, the researchers aimed to gain a deeper understanding of the current system for calculating nutritional status. Interviews provide an opportunity to capture subjective perspectives, personal experiences, and nuanced information that cannot be obtained through other means.

Lastly, the researchers employed observation as a direct data collection method. Through careful and systematic observation, they aimed to capture the actual behaviors, processes, and workflows taking place within the studied context. By immersing themselves in the field and witnessing the actions and interactions firsthand, the researchers gained valuable insights into the object of study. The observations were recorded meticulously to ensure accuracy and completeness.

Overall, this comprehensive data collection approach enabled the researchers to gather diverse types of data, including quantitative data from the literature study and qualitative data from interviews and observation. This multi-faceted approach provides a robust foundation for the subsequent analysis and interpretation of the findings.
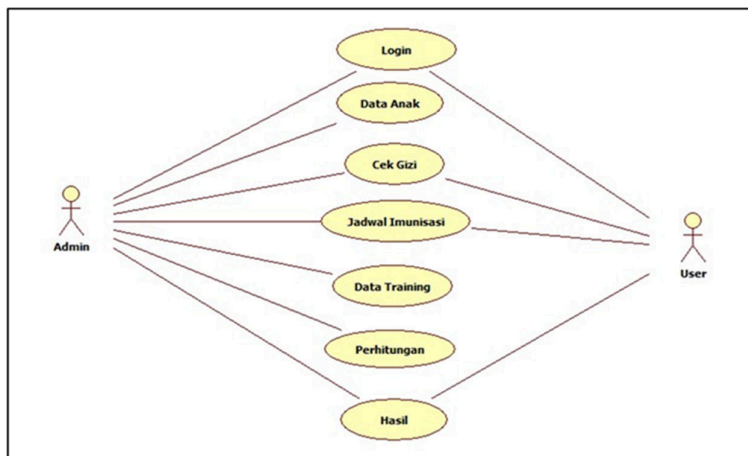
2.4. System Planning

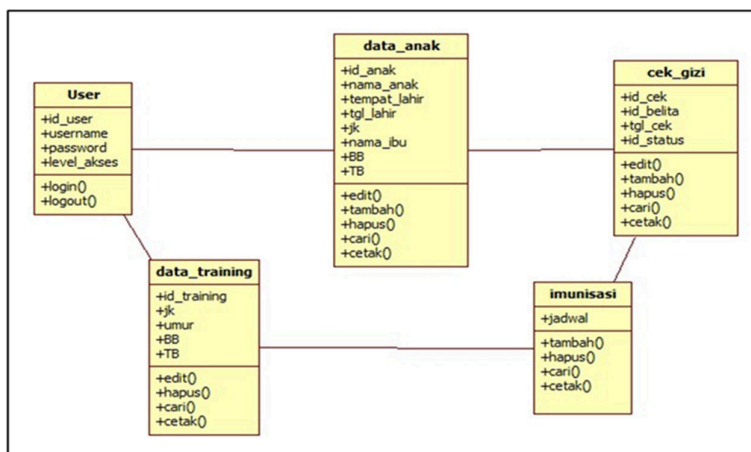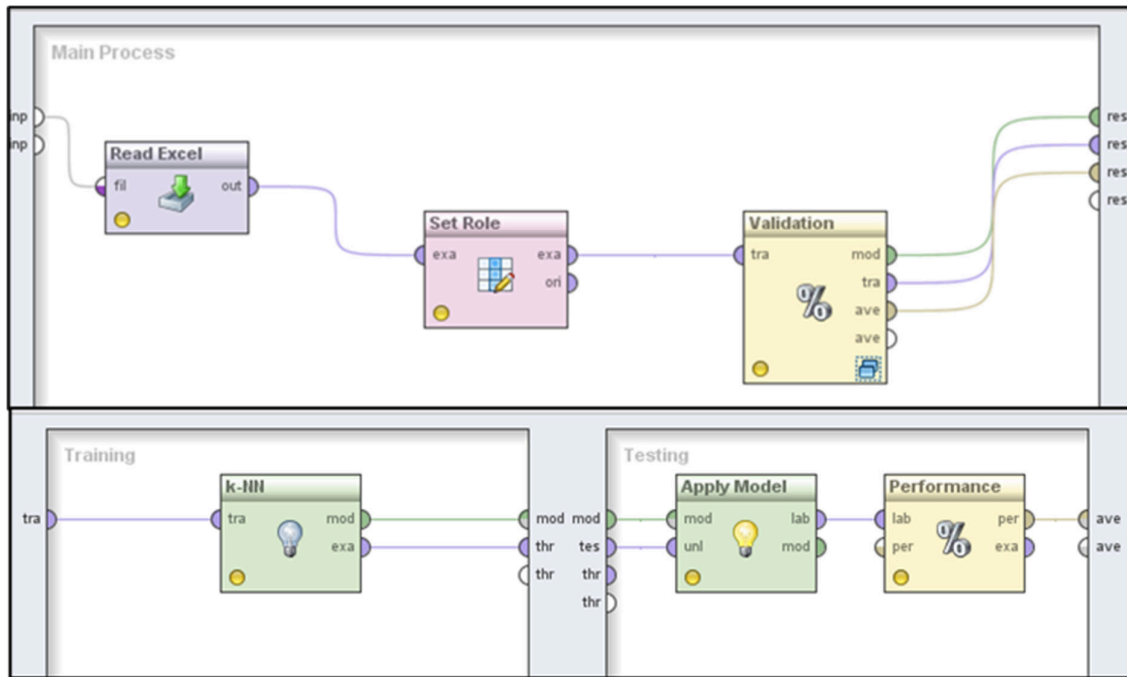**Figure 2.** Use case diagram of child growth and development.

Figure 3. Class diagram of child growth and development.

3. RESULTS AND DISCUSSION

Testing Data Testing which totaled 25 data and Data Training 75 samples of early childhood data in **Figure 4**.

Figure 4. The K-Nearest Neighbor Testing Process from Testing Data.

The picture above shows that the testing process is added by the roll set operator, validation, apply model and performance.

The set roll operator functions as a pattern of behavior to channel two lines from one input data testing to validation, and from validation it continues to the k-nearest neighbor to be processed by the apply model operator without changing the input data testing earlier, and the results of the apply model are forwarded to the performance operator. to test the level of accuracy.

After the data testing process is complete, the results of the data accuracy are shown in **Table 1**.

Table 1. Testing KNN Accuracy Results from Data Testing

Accuracy.81.67%+/-32.02% (mikro:84.00%)			
	True LACK NUTRITION	**True GOOD NUTRITION**	**Class Precision**
Pred. MALNUTRITION	13	1	92.86%
Pred. GOOD NUTRITION	3	8	72.73%
Class Recall	81.25%	88.89%	

In the **Table 1.**, it is noted that the results of the accuracy of the K-Nearest Neighbor from the testing data are 81.67%, with a presentation of undernourishment of 81.25%, and good nutrition of 88.89%, with respective grade precision values of 92.86% for undernourished and 72.73% for good nutrition.

Table 2. KNN Accuracy Results from Training Data

Accuracy.77.08%+/-12.59% (mikro:76.71%)			
	True LACK NUTRITION	**True GOOD NUTRITION**	**Class Precision**
Pred. MALNUTRITION	13	1	92.86%
Pred. GOOD NUTRITION	3	8	72.73%
Class Recall	81.25%	88.89%	

In the **Table 2.**, it is noted that the results of the accuracy of the K-Nearest Neighbor from the testing data are 77.08%, with a normal presentation of 73.08%, and thin 78.72%, with each class precision value of 65.52% for normal and 84.09% for thin.

Table 3. Comparison of training and testing data accuracy values

No	Scheme	KNN
1	Training Data	77.08%
2	Data Testing	81.67%

In the **Table 3.**, it is noted that the KNN algorithm with training data has an accuracy value of 77.08% while data testing has a value of 81.67%, indicating that the accuracy value of testing data is greater than training data.

4. CONCLUSION

Based on the results of research and discussion related to determining the nutritional status of toddlers at *Posyandu* M.Toha Mangkalaya, the researchers draw the following conclusions:

1. The Decision Support System for the nutritional status of toddlers using the K-Nearest Neighbor is able to determine the nutritional status based on the parameters of the toddlers who will be checked using the Z-score formula to normalize the values for each parameter before calculating the distance using the Euclidian distance formula. Classification is carried out if the value of the distance between the training data and the data being tested has been sorted based on the shortest distance which is then drawn a conclusion based on the predetermined K value.

2. 2.The creation of this system was built based on the results of the needs analysis and system design described in the previous chapter in the form of a UML (Unified Modeling Language) model. At the analysis stage, system development requirements are obtained from the results of observations and interviews with related parties. In the following stages, system development is carried out based on the results of system analysis and implementation.

3. At the time of classification using the K-Nearest Neighbor (KNN) method, after the process of forming the classification accuracy value of the ROC and AUC curves shows that the K-Nearest Neighbor (KNN) algorithm with training data has an accuracy value of 81.67% while data testing has an accuracy value 77.08%.

4. Testing the feasibility of the system was carried out by 6 testers including 3 IT experts (IT practitioners) and 3 users (midwives, cadres and parents of children), testing by the IT field got a score of 72% which got a score which was included in the agree

category, while testing by users get a score of 73% included in the agreed category for the system to assist in the process of determining the status of child development.

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. Authors confirmed that the paper was free of plagiarism.

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