



## Web-Based Expert System Detects Malnutrition in Toddlers with the Naïve Bayes Method

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### ABSTRACT

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Nutrition is the supply of ingredients or food that both organisms and cells in the human body need to be able to: survive. While in the field of science and medical, nutrition may refer to: the science or practice of consumption as well the use of food. Malnutrition is a technical term commonly used in: nutrition, health, and medicine circles. Malnutrition: the condition of a person whose nutrition is below average. Symptoms of malnutrition can also be felt with following characteristics such as: fatigue, loss of appetite, impaired vision, growth and poor intellectual development too. According to the Basic Health Research in 2018, the percentage of the number of malnourished toddlers in Indonesia is: as much as 3.9% and malnutrition is: 13.8%. This study aims to detect malnutrition aged 1-5 years (toddler). This research uses: the Naïve Bayes method. In this study, there're known to be types of disease based on the symptoms, namely: Kwarshiorkor (P1), Marasmik-Kwarshiorkor (P2), Marasmus (P3) with 24 symptoms of malnutrition. With this research, it is expected to: help in the prevention of diseases and minimize the symptoms of malnutrition in toddlers.

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## 1. Introduction

Malnutrition in general often occurs in developing countries such as Indonesia and affects children. The World Health Organization (WHO) states that more than 50 percent of children under five die due to malnutrition. The risk of dying under five with malnutrition is 15 times greater than that of normal children in general. The main problem with malnutrition is the lack of food intake with sufficient energy and protein content in children and toddlers. In addition, economic problems and the lack of knowledge from each parent about the importance of nutrition for the development of children are also one of the causes of malnutrition in children or toddlers [1].

A balanced nutritional pattern is very important for a child's growing period. Because growth and development factors as well as intelligence are greatly influenced by nutrition. Often parents think that the nutritional intake their child gets is sufficient and good, so they never check it with a nutritionist. So that if the child experiences malnutrition, it is likely that there will be delays in handling. Most of the parents lack knowledge of nutritional problems. So that children or toddlers become prone to malnutrition. Malnutrition must be treated immediately, because if it is late in the treatment action it will cause death. In Indonesia itself, there are still problems with malnutrition in several regions, especially in the eastern part of Indonesia [2].

The Naive Bayes Algorithm is a classification method using probability and statistical methods. All classification algorithms attempt to form models that have high accuracy or (low error rate). Generally, the model that is built correctly predicts all the data that is the training data, but when the model is faced with test data, then the model performance of a classification algorithm is determined. Training algorithms that have been developed by researchers, such as K-Nearest Neighbor, Artificial Neural Network, Support Vector Machine and so on. What symptoms indicate that someone is suffering from malnutrition at the age of five is the main problem in this study. Each algorithm has advantages and disadvantages, but all algorithms have the same principle, namely conducting a training so that at the end of the training, the model can correctly map (predict) each input vector to the output class label. Assuming an independent variable, only the variance of a variable in a class is needed to determine the classification, not the entire covariance matrix [3].

## 2. Literature review

### 2.1 Definition of Malnutrition

Malnutrition is: nutritional status based on the weight index of: age (BW / U) which is also the equivalent of the terms underweight (malnutrition) and seriously underweight (malnutrition). Toddlers are called malnutrition if the body weight index for age (BW / U) is less than -3 SD (Ministry of Health, 2011). Severe malnutrition: a technical term that is generally used: nutrition, health and also medicine circles. This is the worst form of the chronic malnutrition process[4].

### 2.2 Definition of the Internet

The definition itself of the Internet: a connection between various sets of computers that are also connected to each other[5].

### 2.3 Definition of Online

Online (English: Online) has a certain meaning in the form of telecommunications which means: connected to a network[6].

### 2.4 Definition of Website

Website is: a collection of pages that can be connected universally as well as from sites that contain a collection of information provided: individuals, groups and organizations[7].



**2.5 Definition of Expert System**

Artificial Intelligence (Artificial Intelligence) is one part of: computer science that allows computers to do work as humans do.[8].

**2.6 Definition of Naïve Bayes**

The Naïve Bayes Classifier is a simple probability classifier based on: Bayes theorem. The advantage of the Naïve Bayes Classifier: it requires only a small amount of training data to predict the parameters (means and variance of variables) in the classification process. In the process, the Naïve Bayes Classifier assumes that the presence or absence of a feature in a class is not related to the presence or absence of other features in the same class.[9].

The calculation steps for the Naïve Bayes method are as follows:

- a. Determine the categories that emerge from based on training data
- b. Calculate the probability value of disease and symptoms
- c. Calculate the Bayes value from the probability of disease and symptoms that arise
- d. Specifies the percentage of the category's predicted value.

In the process, the naïve bayes probability formula is as follows:

$$P(H|X) = \frac{P(X|H)P(H)}{P(X)}$$

Where:

X: is an unknown data class

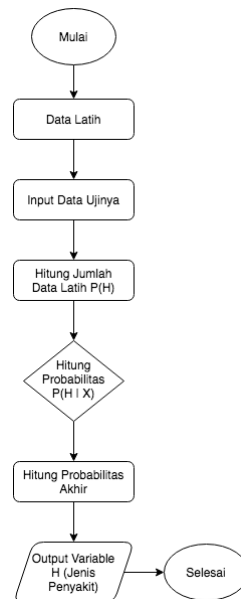
H: the data hypothesis is class specific

P (H | X): is the probability of hypothesis H of condition X (posterior probability)

P (H): probability of the hypothesis in H (prior probability)

P (X | H): probability X based on condition H

P (X): probability of X.



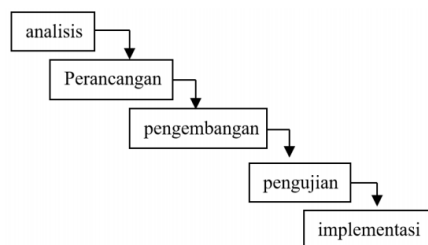
**Fig1.**Flowchart Naïve Bayes

In the picture, describes the steps: calculations from: The Naïve Bayes method that is implemented in the system being created.

**3. Research methodology**

**3.1 Software Development Methods**

In this library also used a system creation method, namely: System Development Life Cycle (SDLC) with a model: Waterfall as shown in Figure:



**Fig 2.** SDLC Model Waterfall

This method: the approach used also in the software industry to project development from: small-scale project size, medium-scale and large-scale projects[10].

This development method itself has stages in it including: needs analysis (analysis), design (design), development (development), and also the testing phase (testing), as well as real environment implementation (implementation)[10].

**a. Analysis Software**

This process is carried out intensively to: get the specifications of the software requirements so that it can be



easily understood by the needs of the user, making online checks easier and more efficient.

**b. System planning**

This process is carried out by a multi-step process that focuses on the design of programming and software architecture, designing the interface system, and the coding process. This stage is for software requirements rather than the needs analysis stage by the seller so that the finished design can be easily understood and accessed by: users through online media.

**c. Program Code Creation**

The design that is made can be entered into: in the software program. The results at this stage are: the website is in accordance with the design that was created in the design stage.

**d. Testing**

This test focuses from: a functional point of view & ensures that all parts have been tested in order to minimize errors when this program is used by the user to achieve definite results.

**3.2 Data collection technique**

The methodology used in this final project is:

**a. Observation**

Where the authors get an overview and examples of the system created by: direct observation in the field regarding the symptoms of malnutrition.

**b. Literature Study**

Namely: theories obtained through books and journals related to the web and expert systems.

**4. Results and Discussion**

To be able to make the application later we will design various analyzes, in the design it is also determined as in the design in general: needs analysis, application performance is running and also the implementation of the application results.

**4.1 Needs Analysis**

The needs analysis is obtained: the user can directly see and also consult about nutrition.

The solution to the proposed problem is in making expert websites to solve problems and make it easier for users to see & consult without having to come to the doctor:

**a. User Requirements**

In an e-commerce application there are two users interacting with each other in a system environment: the Customer chart and the admin chart. As follows:

**1) Nutrition Matriculation**

Users can immediately start for consultation by answering the questions listed on the website screen.

**2) Nutritional Calculations**

Users can immediately see directly the calculated results based on the total questions that have been completed.

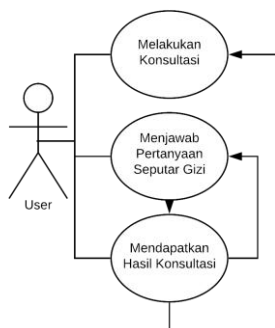
**b. System Requirements**

System requirements explain how in what processes the system will carry out. System requirements also contain any information that must exist and are also generated by the system. The following is an analysis of system requirements in this application, which are as follows:

- 1) The user must answer each of the questions that will be asked in the consultation table.
- 2) The user can see the consultant's results on nutrition without having to bother to create an account.
- 3) The user can also see the suggestions that have been listed after completing the questions.

**4.2 Use-Casein System Proposal**

The following are: use-cases that will also be proposed for the manufacture of this system, namely:



**Fig 3. Use-Case Nutrition Detection Expert System**

**4.3 Class-Diagramin System Proposal**

The following is: a class diagram that can be proposed for the manufacture of this system, which can be seen in the image below:

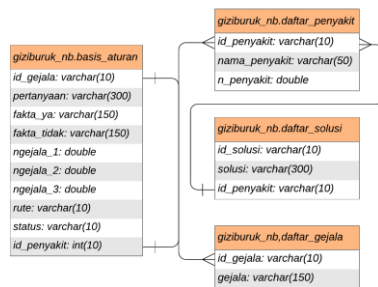


Fig 4. Class Diagram for Nutrition Detection Expert System

4.4 Implementation on Web Pages

The following is: the implementation results on the web from several depictions of the flows that have been made, the following is the explanation:



Fig 5. Main page of Nutrition Detection Expert System

In a home page this functions, namely: the Consultation and Login button to also start the malnutrition disease consultation section and also the system in the footer section.

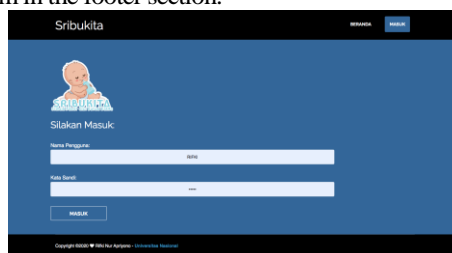


Fig 6. Login Page for Nutrition Detection Expert System Consultation

This login page functions for: we are required to enter in order to start the diagnosis by the questions that will be asked to be able to analyze the nutritional results listed accordingly.



Fig 7. Self-Diagnosis Page from Nutrition Detection Expert System Consultation



Fig 8. Self Diagnosis Questions Page from Nutrition Detection Expert System Consultation

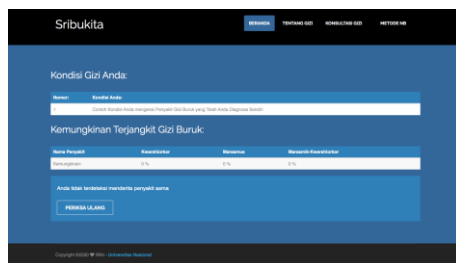


Fig 9. Results Page of the Nutrition Detection Expert System Consultation



Fig 10. Admin page on the Nutrition Detection Expert System

On this admin page, the features function: Symptoms, Diseases, Solutions, Users and also the Rules Base to start data management automatically and also easily.



Fig 11. Symptom Detail Page at the Nutrition Detection Expert System Consultation



Fig 12. Page Add Symptoms in Nutrition Detection Expert System Consultation



Fig 13. Page Update Symptom List in Nutrition Detection Expert System Consultation



Fig 14. Detail Page of Rules Base on Nutrition Detection Expert System Consultation

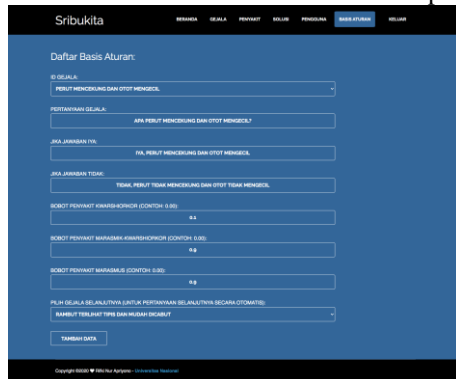


Fig 15. Page Add Rule Base on Nutrition Detection Expert System Consultation



Fig 16. Page Update List of Basis Rules for Nutrition Detection Expert System Consultation

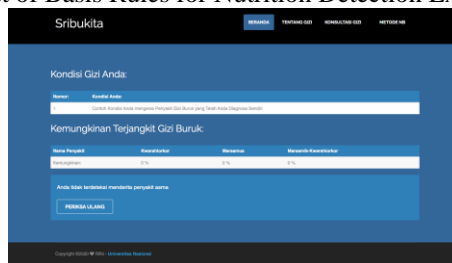


Fig 17. Results Page of the Nutrition Detection Expert System Consultation

In the consultation results page, it is possible to analyze the results of: nutrition of the user, suggestions are displayed and the user can repeat the consultation again.

**5. Conclusion**

From the discussion with the results above, it can be concluded as follows:

- a. With the web for consultation media, it will increase flexibility in nutrition consultation without having to bother going to a doctor.
- b. With this website, users do not need to worry and be too late to be able to overcome malnutrition.
- c. With this website too, users can easily consult without having to register.

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