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Application of Diet Program Monitoring Using Intelligent System

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ABSTRACT: *Having an ideal body is the hope of everyhumanbeing. One effort to achievethisis by doing a diet program. The lack of knowledge and concern for nutritional balance in the body and difficulty monitoring weightdevelopment are the causes of the failure of the diet program. In thisstudy an application wasdeveloped to monitor the diet program intelligentlyusing the Certainty Factor method. The developed application consists of five stages. The first stage isdetecting body weightincludingthin, normal or obese using the Body Mass Index (BMI). The second isdetermining the dailyenergyneeds (calories) that are right for the user. The thirdisdetecting the number of calories burned. The fourthis to detectdiseases due to obesityusing the Certainty Factor method. The fifthis a graphic display of the development of the diet process. The results of thisstudy are expected to providetools to monitor the diet program automatically, sothat the diet program is not successful.*
Keywords:*Certainty Factor, Diet, BMI, Calories.*

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I. INTRODUCTION

Diet is often interpreted as an effort to lose weight by reducing food portions and limiting the type of food. This causes many to assume the diet only needs to be lived by overweight people who want to be thin. Diet in the real sense is a balanced nutritious diet to achieve many different goals, depending on each individual. While dietary behavior can be interpreted as an activity to deliberately limit the form of calorie nutrition, which is intended to get a thinner body shape [1]. The lack of knowledge and concern for nutritional balance in the body is the cause of the failure of the edit program. Existing applications are currently limited to applications for guidance on how to diet and how to calculate the calorie intake needed by the body only.

Research on development of diet programs has been done. The first study was research from Mega [2]. This research produces an application that can monitor development of nutritional status digitally mobile by using anthropometric methods and can provide advice in accordance with development of nutritional status and age of infants and toddlers. This system uses the Anthropometry method. Anthropometric index used is body weight according to age, height by age and weight by height. The second study is research from FakhrunNisa'ulAzizah [3]. The application made is an application to calculate the ideal body weight, the number of calories your body needs and provide information about the nutritional content of food and increase the number of calories burned based on two types of sports activity choices namely walking and running. The method used to calculate calorie requirements is the Harris Benedict method, while the calorie burner uses the exercise calorie formula. Application of a diet program based on sports activities can help and facilitate for users who want to do a diet program by providing information about weight control, nutritional intake of food and calories needed by the user's body.

Research on the development of obesity applications has been done. The first study was research from Mega [4]. This research produces an application that can monitor the development of nutritional status digitally mobile by using anthropometric methods and can provide advice in accordance with the development of nutritional status and age of infants and toddlers. The design in building this system with the Anthropometry method. Anthropometric index used is body weight according to age, height by age and weight by height. The second study is research from FakhrunNisa'ulAzizah [4]. The application made is an application to calculate the ideal body weight, the number of calories your body needs and provide information about the nutritional content of food and increase the number of calories burned based on two types of sports activity choices namely walking and running. The method used to calculate calorie requirements is the Harris Benedict method, while the calorie burner uses the exercise calorie formula.Application to monitor diet programs based on this activity can help users who want to do a diet program easily. This application provides information about weight control, nutritional intake of food and calories needed by the user's body. The third study was a study from WeniKurdanti [6], who conducted research on the factors that influence the incidence of obesity in adolescents. The independent variable is the intake of macro nutrients, fiber intake, fast food consumption patterns, consumption patterns of sweet foods or drinks, physical activity, psychological factors (self-esteem), genetic factors, and breakfast intake, while the dependent variable is the incidence of obesity. Adolescents who have

excessive macro nutrient intake, frequent frequency of fast food consumption, inactive physical activity, having mothers and fathers with obesity status, and not eating breakfast, are at greater risk of obesity.

In this study an intelligent application was developed to monitor a diet program using the Certainty Factor method.The application developed can determine the ideal weight, balanced nutritional intake, determine the recommended daily nutritional intake, in addition, this application can detect diseases caused by obesity, as well as display graphs of body weight development, which are not found in existing applications.The developed application consists of five stages. The first stage is detecting body weight including thin, normal or obese using the body mass index automatically. The second detects diseases due to obesity using the Certainty Factor method. The third detects the need for balanced calories for the body. The fourth is to provide recommendations for proper nutrition or daily energy intake (calories) for the user. The fifth is a graph display of weight development.With this application it is expected that the process of monitoring a diet program can be done quickly, cheaply and practically with high accuracy. This application is expected to be used by anyone (who is of productive age and not pregnant women), including helping the work of nutritionists, especially nutrition counselors in the diet program, while also helping in determining the appropriate daily nutritional intake recommendations for users.

II. MATERIAL

This study uses data from the results of examinations of people who are doing a diet program. The data taken consisted of data on age, weight, height and type of activity. The data used amounted to 30 data.

III. METHOD

Research on applications to monitor diet programs developed consists of two main things, namely applications to monitor diet programs and applications to detect diseases caused by obesity using an intelligent system. Each of which will be explained in detail as follows.

3.1. Diet Program Monitoring

This research relies on nutrition theory especially adult nutrition which includes: knowledge about diet, detection of nutritional status based on Body Mass Index (BMI), determination of calorie requirements that are right for the body and detection of diseases caused by nutritional disorders especially diseases due to fat disorders. Thus knowledge about nutrition will greatly support the success of this research.

The steps in the application development process to monitor diet programs include:

a. Application Development for Detecting Ideal Body Weight.

In calculating the Ideal Body Weight (IBW) For ages over 12 years using the standard Brocca [7]. The formula for calculating the ideal body weight is as follows:

$$IBW = (BH - 100) - (10\% (BH - 100)) \quad (1)$$

Where IBW is the Ideal Body Weight in kilograms (kg) and BH is Height in centimeters (cm).

b. Determine Energy Needs

The main component for determining energy needs is the Basal Metabolism Rate (BMR). Basal metabolic rate is the minimum energy needed by the body to carry out bodily processes expressed in kilocalorie units and physical activity. The basal metabolic rate used in this study uses the Harris Benedict formula [8]. Calculation of basal metabolic rate between men and women is distinguished. To calculate the basal metabolic rate for men and women are shown in equations 2 and 3 below:

MBR for Men:

$$66+(13,7 \times BW)+ (5 \times BH) -(6,8 \times A) \quad (2)$$

BMRfor Women:

$$655+(9,6 \times BW)+ (1,8 \times BH) -(4,7 \times A) \quad (3)$$

Where BW is weight in kilograms (kg), BH is height) in centimeters (cm) and A is age in years. After the BMR value is known, the next step is to find out the type of physical activity. The grouping of physical activity weights can be seen in Table 1.

Table 1. Weight of Physical Activity

Activity	Gender	
	Pria	Wanita
Very light	1.30	1.30
Light	1.65	1.55
Medium	1.76	1.70
Weight	2.10	2.00

The physical activities according to the 1989 RDA are as follows:

Table 2. Activity Categories

Activity Categories	Activity
Break	Sleep, lie down or lean back
Very Light	Sit and stand, paint, drive cars, laboratory workers, typing, sweeping, ironing, cooking, playing cards, playing musical instruments
Light	Walking at 2.5 - 3 mph, working in a workshop, work related to restaurants, cleaning the house, babysitting, golfing, fishing, table tennis
Medium	Walking at 3.5 - 4 mph, pulling grass and hoeing, crying loudly, cycling, skiing, tennis, dancing
Weight	Hiking, cutting trees, digging the ground, basketball, rock climbing, soccer.

Source: RDA 10th edition, National Academic Press, 1989 [9].

After getting the value of physical activity in accordance with the type of activity, the next step is to multiply the value with the BMR shown in equation 4.

Energy Needs = value of physical activity x BMR (4)

The value of energy requirements for BMR is calculated according to normal or ideal body weight using the Body Mass Index (BMI) as in Equation 5.

$$\text{BMI} = \text{Weight (Kg)} / \text{Height (m)}^2 \quad (5)$$

This BMI value is used as the body condition threshold as in Table 3.

Table 3. Threshold for Body Mass Index

Body Condition	Category	Threshold Limit
Thin	Weight loss weight level	<17.0
	Mild weight loss	17.0-18.5
Normal		>18.5-25
Fat	Lightweight overweight	<18.5-27.0
	Overweight weight level	<27.0

c. Count Burn Calories

Activities, for example sports require energy which is known in kilos of calories.This energy source comes from fat or from glycogen. Many factors affect the calories burned during activity.First and foremost is the adaptation of our body and the second factor is muscle volume.Another factor is body weight, intensity of activity and the metabolic condition of the body itself.Exercise requires energy which is known in kilos of calories. This energy source comes from fat or from glycogen.Many factors affect the calories burned during exercise.First and foremost is the adaptation of our body and the second factor is muscle volume.Other factors are body weight, exercise intensity and the metabolic condition of the body itself. By research, every sport movement is sought for its MET (metabolic equivalent of task) value.Which is an estimated number of calories burned while doing sports activities in a certain time, then compared with the estimated volume of body muscle mass. In addition to finding calories burned while exercising, you can also use the same calculation to calculate how many calories are burned for daily activities. The basic formula is as follows[1]:

EC = {[MET x 7.7 x BB(pound)] / 200} x t (6)

With EC is Exercise Calorie, MET is Metabolic Equivalent of Task, BB is Weight and t is time (minutes). Metabolic Equivalent (MET) is a ratio of work metabolic rate (metabolic value at work) to resting metabolic rate (metabolic value at rest).

3.2. Detection of Obesity Diseases

Development of software to detect diseases caused by obesity using intelligent systems.The intelligent system used in this study is the expert system (Expert System) [11] - [14].Expert System (Expert System) is a computer-based application that is used to solve problems as thought by experts.The experts referred to here are people who have special expertise who can solve problems that cannot be solved by ordinary people.An expert system has 2 main components, namely knowledge-based and inference engine.Knowledge based is a place for storing knowledge in computer memory, where this knowledge is taken from expert knowledge.While the inference engine is the brain of the application of an expert system, this is the part that guides the user to enter facts so that a conclusion is reached [15], [16].The intelligent system used is an expert system using the Certainty Factor method [17].

Certainty factor is a method for proving whether a fact is certain or not in the form of a matrix that is usually used in expert systems.This method is suitable for expert systems that diagnose something that is not certain [18].Stages in the Certainty Factor method include: a. The ability to express degrees of confidence in accordance with the methods discussed earlier. b. The ability to place and combine these degrees of confidence in the expert system.In expressing the degree of confidence used a value called Certainty Factor (CF) to assume the degree of confidence of an expert on a data. Following are the basic formulations of the Certainty Factor:

$$\mathbf{CF[H.E] = MB[H,E] – MD[H,E]} \quad (7)$$

Where CF is Certainty Factor in hypothesis H which is influenced by fact E, MB is Measure of Belief (confidence level), it is a measure of the increase in confidence of hypothesis H is influenced by fact E, MD is Measure of Disbelief (level of uncertainty), is the increase of mistrust of the hypothesis H influenced by fact E, E is Evidence (event or fact), while H is Hypothesis.The algorithm in detecting diseases caused by obesity can be shown in the figure below.

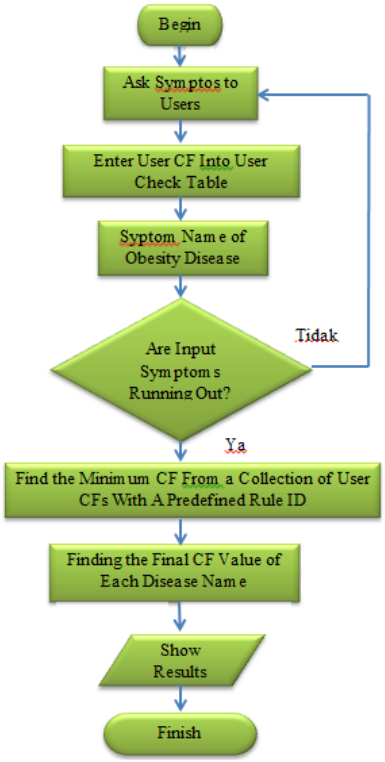

Figure 1. Detection of Diseases Caused by ObesityAlgorithm

Detection results will be compared with groundtruth (doctor) using the ROC method, so that four values will be obtained, each of which is true positive, false negative, false positive, and true negative.True positive (TP) shows the health status identified precisely according to the class. False positive (FP) is the health status of pregnant women who should be correctly identified in their class, apparently in the classification process in identifying wrong.True negative (TN) is a health status that is not a member of the class correctly

identified as not a member of that class. Negative false (FN) indicates the health status that should not be members of the class identified as members of the class. Based on the four values, a true positive rate (TPR) value, known as sensitivity, is obtained. The sensitivity formula is as follows:

$$\text{TPR} = \frac{\text{TP}}{\text{TP}+\text{FN}} \quad (8)$$

False positive rate (FPR) or specificity is a value that indicates the level of error in the identification obtained based on the following equation

$$\text{FPR} = \frac{\text{FP}}{\text{FP}+\text{TN}} \quad (9)$$

While the value that shows the accuracy of the identification (accuracy) is obtained from the following equation:

$$\text{Accuracy} = \frac{\text{TP}+\text{TN}}{\text{TP}+\text{FP}+\text{TN}+\text{FN}} \text{x}100\% \quad (10)$$

IV. EXPERIMENTSAND RESULTS

The software to monitor diet programs that are designed aims to facilitate the user in terms of recording and monitoring during the diet process, monitoring the development of body weight, calorie requirements, and is equipped with a graphical display of monitoring the progress of the diet process.In addition, the system developed also has a detection of diseases caused by obesity.Diseases caused by obesity include diabetes, heart disease and high blood pressure. The Main Menu of the developed application can be seen in Figure 2 below.

Figure 2. Main Menu

For the management of dietary inspection data can be shown in Figure 3. One of the results of decisions taken automatically by the diet program monitoring software can be shown in Figure 4. While the graphical display for easy monitoring of dietary progress can be seen in Figures 5.

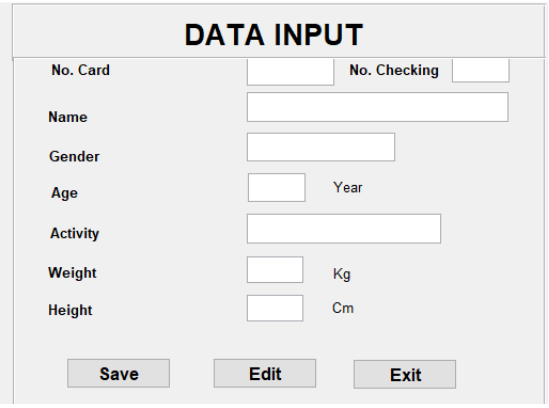

Figure 3. Inspection Data Input Form

Before using application to diagnose disease, users will be grouped into type of Body Mass Index (BMI). BMI is a simple tool for monitoring adult nutritional status specifically related to underweight and

overweight [18]. The IMT threshold category is shown in table 3.To calculate or determine a person's IMT using the following formula:

BMI = Body weight / (Height / 100) ^{2}
After knowing the user's IMT category, then next is to find out what nutritional disorders suffered by the user. For example, someone has a gender: male, height: 174 cm and weight: 80 kg.

BMI = Body weight / (Height / 100) ^{2}
BMI = 80 / (174: 100) ^{2}
BMI = 26.4

The results of detection are shown in Figure 4.

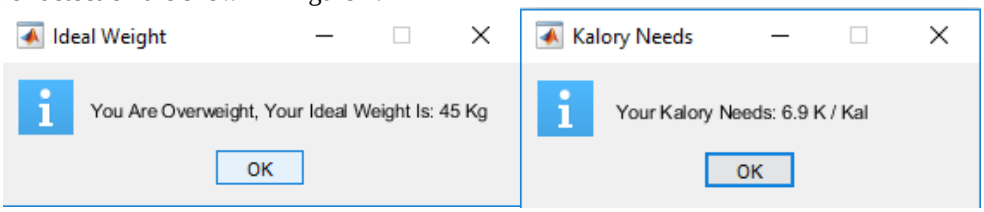

Figure 4. Ideal Body Detection Results and Kalory Needs

The display of weight development is shown in figure 5.

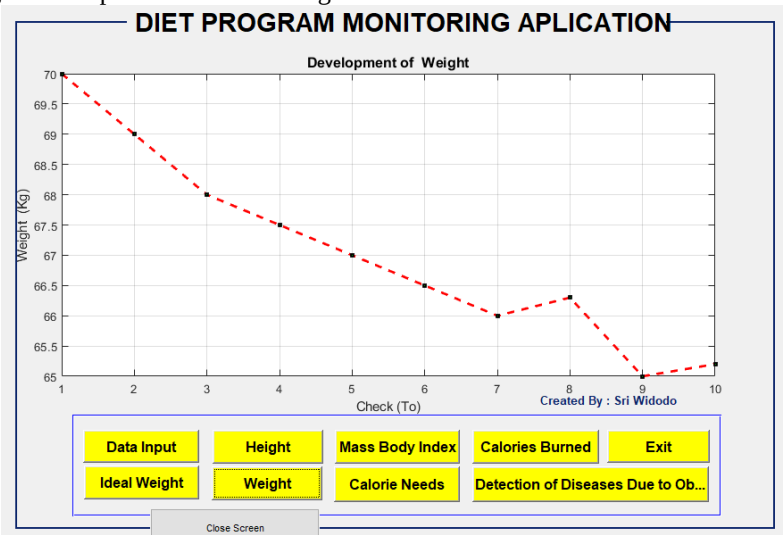

Figure 5. Display Of Weight Development

From calculation above it is known that person is classified as overweight or obese BMI. Therefore, the diseases he may suffer are diabetes, hypertension and heart disease. Based on questions raised using fat IMT inference tree, the symptoms of disease experienced by the patient are known as follows:
1. Do you often feel tired? (Yes)
2. Do you often have headaches? (Yes)
3. Do you often get dizzy (vertigo)? (Yes)
4. Is your face reddish? (No)
5. Is your heart rate fast? (Yes)

Based on the inference tree, the diagnosis is "hypertension". The CF value of each symptom held is as follows:
1. Frequent fatigue, MB = 0.45; MD = 0.15. CF = 0.45 – 0.15. CF = 0.30
2. Headache, MB = 0.85; MD = 0.22. CF = 0.85 – 0.22. CF = 0.63
3. Dizziness (vertigo),MB = 0.92; MD = 0.35. CF = 0.92 – 0.35. CF = 0.57
4. Reddish face, CF = 0
5. Fast heartbeat, MB = 0.90; MD = 0.30. CF = 0.90 – 0.30. CF = 0.60

The next step is the calculation using the Certainty Factor method.
R1 = 0.30; R2 = 0.63, R3 = 0.57; R4 = 0; R5 = 0.60

The calculation process is as follows:

CF(R1,R2) = CF(R1) + [CF(R2)]x[1-CF(R1)]
= 0.30 + 0.63 x [1 – 0.30]
= 0.30 + 0.63 x 0.70
= 0,74

CF(R1,R2,R3) = CF(R1,R2) +[CF(R3)]x[1- CF(R1,R2)]
= 0.74 + 0.57 x [1 – 0.74]
= 0.74 + 0.57 x 0.26
= 0.89

CF(R1,R2,R3,R4) = CF(R1,R2,R3)+[CF(R4)]x[1-CF(R1,R2,R3)]
= 0.89 + 0 x [1 – 0.89]
= 0.89 + 0 x 0.11
= 0.89

CF(R1,R2,R3,R4,R5) = CF(R1,R2,R3,R4)+[CF(R5)]x[1- CF(R1,R2,R3,R4)
= 0.89 + 0.60 x [1 – 0.89]
= 0.89 + 0.60 x 0.11
= 0.95

Calculation results above, it can be seen that the level of confidence of the results of the diagnosis of hypertension in these patients is 0.95 or 95%. The detection process starts from the user answering questions raised by the system. The display of questions is shown in Figure 2.

Figure 6. Display Questions From the System

After user answers the questions raised by the system, system will then display results of the diagnosis and value of the hypothesis. The results of the detection process are shown in Figure 3.

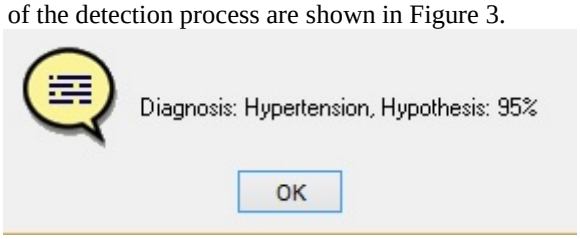

Figure 7. Display of Obesity Disease Detection Results

V. CONCLUSION

Based on the test results by comparing the results of system diagnoses with diagnoses from nutritionists, an accuracy of 90% was obtained. This shows that the Certanty Factor method can be used to detect diseases caused by fattening.

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