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Software Development to Monitor Nutritional Status of Pregnant Women Using Intelligent Systems

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ABSTRACT : *The current method used by Indonesia to monitor the nutritional status of pregnant women using Healthy Pregnancy Card of Pregnant Women. How to do is to make measurements and categorization with Body Mass Index Indicator (BMI), Top Arm Circumference and Hemoglobin or Hb levels. The problems that arise are health workers difficulties in determining the nutritional status and anemia of pregnant women every month. In addition, the determination of nutritional status and anemia of pregnant women manually less accurate, this is because the determination is only based on one indicator, can not be several indicators at once. Another problem is the difficulty in documenting pregnant maternity medical record data. If Healthy Pregnancy Card ofPregnant Mother is missing, data on the development of nutritional status and anemia of pregnant women can not be traced. The objective of study was to develop intelligent software to monitor nutritional status and anemia of pregnant women. This research consists of 3 main points. First is the management of maternity medical record data. The second is to detect the nutritional status and anemia of pregnant women using Support Vector Machine (SVM). The third is to develop software to display a chart of the development of nutritional status of pregnant women. Accuracy of detection of nutrient status of pregnant mother is 95.3%.*
KEYWORDS *-BMI, Pregnant Mother, Healthy Pregnancy Card, SVM*

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I. Introduction

Currently, the case of malnutrition becomes a matter of concern in Indonesia. Malnutrition is a problem that needs attention, because it can cause the lost generation. The quality of the nation in the future will be greatly influenced the state or nutritional status at this time, especially toddlers. Due to malnutrition will affect the quality of one's life in the future. There are various ways to assess nutritional status. One is by measuring the human body known as anthropometry. Measurements of anthropometry that can be used include: weight, body length or height, upper arm circumference, head circumference, chest circumference. In addition to malnutrition, the problems that exist in Indonesia is about Maternal Mortality Rate (MMR). Maternal Mortality Rate (MMR) is one indicator of the success of health services in a country. Maternal deaths can occur for several reasons, such as anemia. The results of Hanim analysis [1] show that the maternal mortality rate in Indonesia is 70% for mothers who are anemic and 19,7% for those who are non anemic. Maternal death 15-20% is directly or indirectly related to anemia. Anemia in pregnancy is also associated with increased maternal illness [2]. Definition Anemia in pregnancy is a condition with hemoglobin levels below 11 gr% in the first and third trimesters or hemoglobin level <10.5gr% in trimester II [3]. Anemia is a condition in which red blood cells decrease or decrease hemoglobin, so the capacity of the oxygen carrying capacity for the needs of vital organs in the mother and fetus is reduced. During pregnancy, anemia indication is if the concentration of hemoglobin is less than 10.50 to 11.00 g / dl [4]. Hemoglobin (Hb) is a component of red blood cells that function to deliver oxygen throughout the body, if Hb is reduced, the body tissue lack of oxygen. Oxygen is required by the body to fuel metabolic processes.

Current methods used to detect nutritional status of pregnant women by measuring and categorizing with Body Mass Index Indicators (BMI) and Top Arm Circles [5]. Meanwhile, to determine the anemia of pregnant women using the results of measurements of hemoglobin (HB). Similarly, health services for pregnant women during pregnancy with antenatal care standards are: weigh weight and measure height, measure blood pressure, complete immunization, measuring fundus height of uteri, and giving tablets of at least 90 tablets of iron during pregnancy. As a result the process of detection of nutritional status of pregnant women takes a long time and the results are less accurate. Other problems are non-continuous medical record data and difficulty in searching data.

Studies on the detection of nutritional status and anemia of pregnant women have been widely practiced. The first is research conducted by Anggraeni [6]. His research on decision support system for

diagnosis of anemia disease using Simple Additive Weighting (SAW) method which this research contains about early detection of Anemia disease which can be used by doctors and general public in early diagnosis of disease. From the results of his research said that Decision Support System In Diagnosis Anemia disease with Simple Additive Weighting method (SAW) can be applied to determine the type of anemia disease suffered by the community. Wulandari[7] conducts research on expert systems to diagnose diseases caused by nutritional disorders using the Certainty Factor method along with his nutritional recommendations. This system will group users by category Body Index (BMI), the category of thin, normal and fat. This grouping is because each category of BMI has the possibility of different illnesses. This system works by doing diagnosis based on the symptoms of the disease felt by the user, then perform calculations based on the value of Certainty Factor from each of the symptoms that exist. Based on the results of testing with a comparison between the diagnostic results of the system and nutritionists, it is known that 90% of the diagnoses get the same results so that the system can be said worthy to use. Indrawaty[8] created an expert system to find out nutrition fulfillment and early detection of web pregnant women's health. Expert systems are made to know the nutritional status based on body weight and food intake as well as symptoms of pain felt by pregnant women. This expert system uses a forward chaining inference engine, with a representation of the frame's knowledge to determine the nutritional fulfillment status, while for health detection using a backward chaining inference engine with a representation of knowledge of production rules. Development of this expert system using web-based programming with PHP and e2glite programming language as a shell expert system. Based on the test results, this expert system of pregnant women can provide nutritional and health conclusions to the symptoms that are felt and can know the details of the disease.Widodo [9] also developed software to detect the nutritional status of toddlerusing intelligent systems, which are equipped with charts to monitor the development of nutritional status of toddler. The method used is the Support Vector Machine. The accuracy rate is 86%.

The purpose of the research is to develop intelligent software to detect nutritional status and anemia of pregnant women. The method used is detection of nutritional status and anemia based on Body Mass Index (BMI) Indicator and Upper Arm Circumference and Hemoglobin level using Support Vector Machine. Decisions resulting from the system are pregnant women with good nutrition and less. As for anemia, the resulting decisions are pregnant women not anemia, mild anemia, moderate anemia, severe anemia.

II. Materials

The data used in this study can be divided into two groups. First is data used as training data.Training data is data to be used in classification process. The data were taken from anthropometric data of pregnant women consisting of: age of pregnancy, weight, height, upper arm circumference, fundus and blood pressure, [1].Second is the data used in the testing process. The data is the data of pregnancy examination results every month. The data were collected at Posyandu Sejahtera Badran, Ponowaren, Tawangsari, Sukoharjo, Middle of Java, Indonesia. The data taken consisted of maternity medical record data and anthropometric data of pregnant mother which include: age, weight, height and upper arm circumference, fundus and blood pressure.

III. Method

A. Medical Record Data Processing

The purpose of data management of maternity medical records is to ensure maternal medical records are well documented, including the status of pregnant women's nutritional development. An example of a form for the management of maternity medical record data can be seen in figure 1.

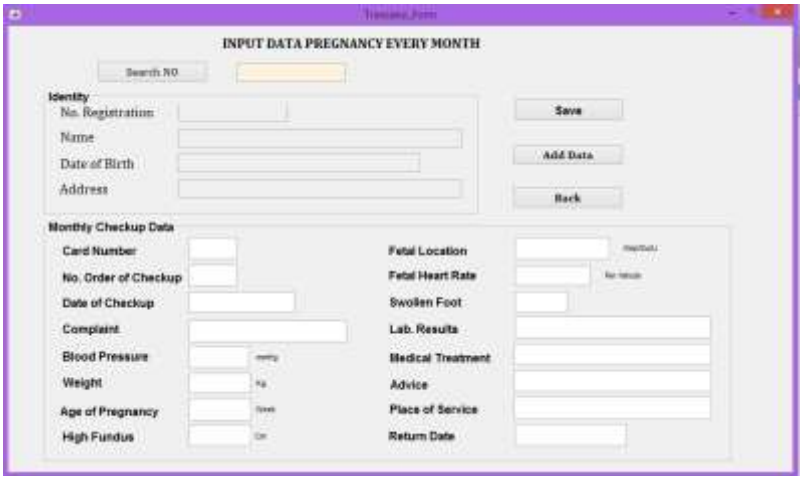

Figure 1. Example of Input Design of Maternity Medical Record Data Management

B. Detecting Nutritional Status of Pregnant Women

The process of detecting nutritional status of pregnant women based on gestational age, weight, height and upper arm circumference. The method used is Support Vector Machine [10]-[12]. The steps of nutritional status detection can be explained as in figure 2.

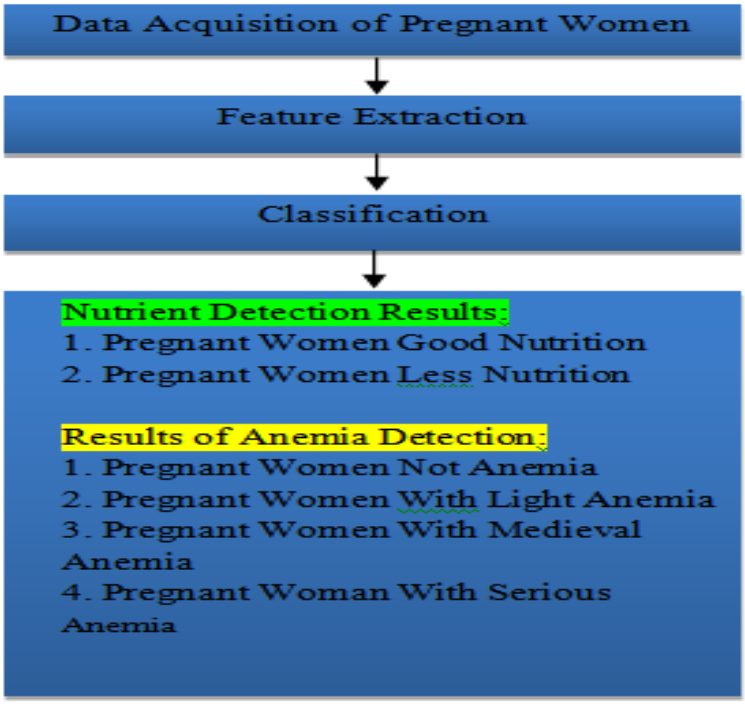

Figure 2. Steps of Detecting Nutritional Status of Pregnant Women

- Data Acquisition From Pregnant Women

Data from pregnant mother consist of pregnant maternity medical record data and anthropometry data which include: age, body weight, body height and upper arm circumference.

- Feature Extraction

Feature extraction is the process for obtaining accurate information for identification [13] - [14]. The features used for the detection of nutritional status of pregnant women consist of: age, weight, height and upper arm circumference features according to World Healt Organization (WHO). The selected features will be used to process the classification of nutritional status of pregnant women which include: Pregnant Women Normal Nutritional Status, Pregnant Women Less Nutrition Status, Pregnant Women More Nutritional Status.

- Nutrition Status Detection Process Using Support Vector Machine (SVM)

The process of detecting nutritional status is done by classification process. One method of classification is the Support Vector Machine (SVM) [11]. Detection of nutrients performed is detection based on Body Mass Index (BMI), based on maternal weight gain each month, upper arm circumference and hemoglobin. The result of this process is the index value of the largest decision function that states the class of test data. If the class generated from the classification process is the same as the test data class, then the recognition is declared true. The end result is normal pregnant women, pregnant women less nutrition, and pregnant women more nutritional nutrients that match the value of the index of the decision function using the SVM method. Development of maternal nutritional status detection application using Matlab programming language [15]. The developed application is aimed to facilitate midwife in recording maternity medical record data, to detect nutritional status of pregnant mother automatically, and to monitor health status through maternal nutrition development chart, among others, graph of weight gain, height and upper arm circumference. Main menu and Graph of development of nutritional status of pregnant women is shown in figure 4 and 5.

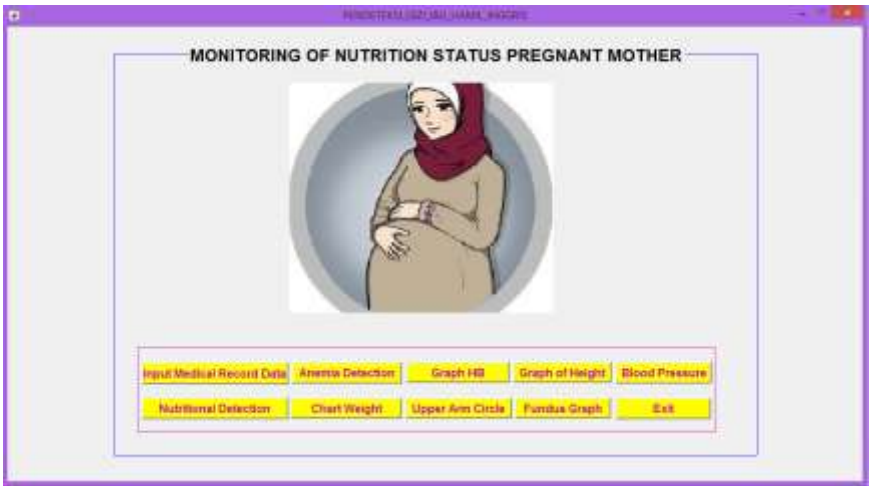

Figure 4. Main Menu

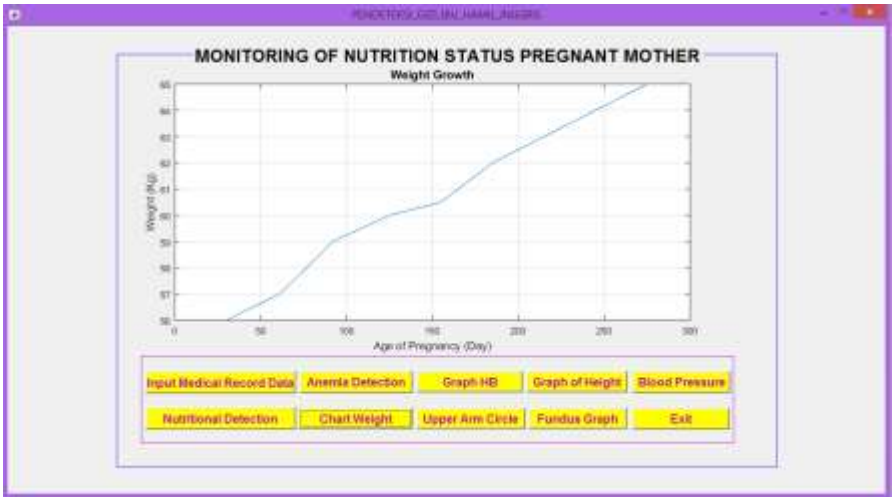

Figure 5. Graph of Pregnant Women Weight Growth

- Calculating Accuracy of Nutrition Status Detection

To calculate the accuracy is done by comparing the classification result done by the system with the result of classification by groundtruth (midwife). The method used is ROC, so that will be obtained four values. Each of these values is true positive, false negative, false positive, and truegegative. Truepositive (TP) shows the identified nutritional status appropriately in accordance with its class. Falsepositive (FP) is a nutritional status that should be properly identified in its class turns out to be in the process of misclassification in identifying. Truegegative (TN) is a nutritional status that is not a member of the class is identified precisely not a member of that class. Falsenegative (FN) indicates the nutritional status that should not be a member of the class identified as a member of that class. Based on the four values, the value of true positive rate (TPR) is known as sensitivity. The sensitivity formula is as follows:

$$TPR = \frac{TP}{TP+FN} \quad (1)$$

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

$$FPR = \frac{FP}{FP+TN} \quad (2)$$

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

$$Accuracy = \frac{TP+TN}{TP+FP+TN+FN} x100\% \quad (3)$$

IV. Experiments And Results

The training data used for the process of detecting nutritional status of pregnant women for each feature is 90.So the amount of training data for detection of all features amounted to 360. These features are features of BMI, Weight Growth Every Month, Upper Arm Circumference and all the features. The data consisted of data 1 to 30 are data of normal pregnant women, 31 to 60 data of pregnant women less nutrition, 61 to 90 are data of pregnant women more nutrition.The number of classes is 3, namely: normal pregnant women, pregnant women less nutrition and pregnant women more nutrition.While the features used to detect nutritional status are age, weight, height and upper arm circumference. Data training for pregnant women's detection based on hemoglobin feature amounted to 80 data.Consisting of four classes, Pregnant Women Not Anemia, Pregnant Women With Light Anemia, Pregnant Women With Medieval Anemia and Pregnant Woman With Serious Anemia. While the taining data for detection of nutritional status of pregnant women using all the data training features used amounted to 80 data.The number of classes is 2, namely Pregnant Women Good Nutrition and Pregnant Women Less Nutrition.Tests were conducted through 5testing using 20 data testing every testing process. The first testing was a trial of nutritional detection method based on body mass index (BMI) that is high and weight. The secondtesting is based on gestational age and maternal weight growth every month. The thirth testing is a test based on hemoglobin to detect anemia of pregnant women. The fourth test is a test based upper arm circumference. The last test is test based on all features. This scenario is used to examine the effect of feature selection consisting of gestational age, weight, height and upper arm circumference on the performance of the maternal nutritional status detection method developed. The results of the first test show a 94.6 % accuracy rate, result of the second test shows an accuracy level of 91.5%, third test shows an accuracy level of 97.2%, fourth test shows an accuracy level of 93.5% and fifth test shows an accuracy level of 95.3%. This suggests that the methods used by using training data can detect very accurately. Test results can be shown in table 1.

Table 1. Results of Data Testing

Number of Testing Data	Result				
	Testing 1 (Body Mass Index)	Testing 2 (Weight Growth Every Month)	Testing 3 (Hemoglobin)	Testing 4 (Upper Arm Circumference)	Testing 5 (All Features)
20	94.6%	91.5%	97.2%	93.5	95.3%

V. Conclusion

Conclusion of research that has been done is that software of detecting nutritional status of pregnant mother with Support Vector Machine (SVM) method proved able to be used as model of detecting nutritional status of pregnant mother. This is indicated by an average accuracy of 95.3%.

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