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Development of Pregnancy Complication Detection Application Using Artificial Intelligence

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Abstract
Pregnancy complication is a complication or disorder or complication that accompanies the mother during pregnancy. The forms of pregnancy complications that cause MMR in Indonesia are: haemorrhage, eclampsia, abortion, pre-eclampsia, prolonged partus, and other causes. The data used includes data on diseases in pregnant women, including: Hyperemesis Gravidarum, Miscarriage, Anaemia, Preeclampsia, and HELLP syndrome. Pregnancy complications are generally found in high-risk pregnancies, but the continuation of pregnancy depends on the health of the mother, placenta and fetus, placenta, and fetal condition. The availability of a mechanism to determine the presence of potential pregnancy complications is a problem in this research proposal. Building a model for determining the presence of potential pregnancy complications based on pregnancy examination data that can provide information on the presence of potential pregnancy complications is one form of utilisation of data recorded in medical records. The data recorded in this system can be used to determine the decision of the patient's pregnancy condition. Backpropagation Artificial Neural Network is the technique employed. In order to develop the backpropagation method, momentum was included. Backpropagation is one of the training methods on neural networks, where the characteristic of this method is to minimise the error in the output produced by the network. The result of this research is a decision support application for the potential onset of pregnancy complications based on facts taken from medical records of pregnancy examinations. The output of the JST model will diagnose pregnant women with normal pregnancies or pregnancies with persalanan complication. The accuracy obtained is an accuracy of 70%.

Keywords: *Maternal Mortality Rate; Backpropagation; Pregnant Women; JST; Pregnant Complications*

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I. INTRODUCTION

Because pregnant women are particularly vulnerable to a variety of health issues, Indonesia continues to have a high pregnancy mortality rate. Maternal mortality, as defined by the WHO, is defined as death that occurs during pregnancy or within 42 days following the end of pregnancy and is brought on by any cause associated with or made worse by pregnancy or its treatment. In Indonesia, the maternal mortality rate (MMR) remains at 359 per 100,000 live births (KH), according to the 2012 Indonesian Demographic Health Survey (IDHS). Compared to the 2007 study, which reported a maternal death rate of 228 per 100,000 KH, this number is significantly higher. In the meantime, lowering the maternal mortality rate (MMR) to 120 per 100,000 live births by 2015 is the global aim of the fifth Millennium Development Goal (MDG) [1]. One issue that still exists is a lack of awareness regarding pregnancy symptoms. This causes pregnant women to overlook some symptoms that could be signs of a serious illness. Furthermore, the delay factor, an indirect cause of maternal death, increases the chance of maternal death. Delay is characterized as a late decision to refer, which includes pregnant women's lack of awareness of pregnancy danger signals. According to the Basic Health Research (Riskesdas) 2010 findings, only roughly 44% of expectant mothers are aware of the warning indicators [2].

The highest percentage of maternal mortality is haemorrhage at 28%, and eclampsia at 24%. Eclampsia in pregnant women can occur due to severe hypertension or pre-eclampsia, which can endanger the life of the mother and future baby in the womb. Pre-eclampsia or preeclampsia is characterised by clinical conditions of high blood pressure, increased protein levels in the urine (proteinuria), and swelling of the limbs (edema). Symptoms of pre-eclampsia often appear during the 20th week of pregnancy until near the time of delivery. The main clinical sign of pre-eclampsia is blood pressure that continues to rise. Thus, it is necessary to monitor blood pressure regularly during pregnancy. The presence of pre-eclampsia symptoms in pregnant women can cause pregnancy complications.

Anaemia is one of the indirect causes of maternal mortality in addition to pre-eclampsia [3]. Pregnancy complications resulting from anaemia are miscarriage, premature birth, uterine inertia (prolonged abnormality caused by muscle fatigue, postpartum haemorrhage, shock, infection. Anaemia that occurs in pregnant women is caused by low nutritional intake and also ignorance in proper diet. Anaemia is a condition where the level (Hb) in the blood is lower than the normal value. The reduction of MMR caused by several diseases complicating pregnancy requires early detection of high-risk pregnancy is an effort that can be done to find pregnant women who have a risk that is likely to occur emergencies [4]. The availability of high-risk detection by health workers that has not met the target [5] is a problem that must be resolved to reduce maternal mortality. An expert system for pregnant difficulties has been used to do research on determining pregnancy complications [6]. this system was built not based on pregnancy examination data, but based on symptoms observed and recorded in the database. This proposed research aims to determine the potential for pregnancy complications based on pregnancy examination data recorded in medical records as a potential detection of the onset of pregnancy complications. The examination data used to support this research is the electronic record of the mother during pregnancy. Electronic medical records contain information about a person's health condition and treatment that is used to make important decisions in the treatment process [7].

The author's solution that can be used by pregnant women in recognising danger signs is an expert system for diagnosing pregnancy complications. Based on the symptoms experienced by expectant mothers and the referral location that the patient has to attend to, the expert system can assist in identifying pregnancy-related issues or diseases. Research on expert systems to detect pregnancy complications has been done by several researchers, including Brigitta, et al [8] (2010) who used the forward chaining method to diagnose diseases of pregnant women. The method was implemented in the diagnosis process through the symptoms felt by the patient and issued an output in the form of a disease suffered by the patient. The percentage of accuracy of the forward chaining method in this study was 87%. Suci [9] (2014) used the Certainty Factor (CF) method to diagnose cervical cancer based on daily life patterns that can be a risk factor for cervical cancer. The system displays the amount of trust in the patient's lifestyle inputted by the patient and the trust result itself is generated from the calculation with the probability method. The percentage accuracy of the CF method in this study is 100%. In order to lower the Maternal Mortality Rate (MMR) and Infant Mortality Rate (IMR), it is anticipated that an expert system utilizing the CF method with a foundation in medical science (obstetrics) and owned by an expert will assist in diagnosing diseases of pregnant women. Additionally, pregnant women will be able to identify potential diseases based on their symptoms.

The Naïve Bayes Classifier method was used in additional research by Effendi [10] titled "Expert System for Diagnosing Diseases in Pregnant Women." The results show that the system can assist pregnant women in identifying early pregnancy diseases and in preventing and treating them based on the symptom data displayed by users when they consult the system. The most recent pertinent study, "Case-Based Pregnancy Disease Consultation Expert System Using Case Based Reasoning (CBR) Method," was carried out by Lubis [11]. The results showed that 80% of pregnant women could use the system as an alternative for conducting disease consultations, demonstrating that the system can manage issues and give them health information.

In light of this, an intelligent application that uses the backpropagation approach to diagnose pregnancy difficulties is suggested as a solution. This application can assist in identifying disorders or diseases during pregnancy based on the symptoms that pregnant women experience. There are two primary components to this study. The creation of software to manage pregnant women's medical record data comes first. The second is the creation of software that uses the Backpropagation Artificial Neural Network expert system method to identify pregnancy issues based on symptoms. It is anticipated that the created application will assist midwives and expectant mothers in identifying pregnancy issues based on the symptoms that expectant mothers experience and the referral location that needs to be attended to by expectant mothers.

II. Method

Pregnant women's diseases have been extensively studied, yet there is still a dearth of study on automatically detecting pregnant women's disorders utilizing expert systems. The first study was conducted by Aryu [12]. Based on the symptoms that pregnant women experience and the referral location that the patient has to attend to, the research aims to develop an expert system for detecting diseases of pregnant women using the Certanty Factor (CF) technique. The CF approach produces outcomes with a high percentage of accuracy and system performance that can operate in accordance with functional criteria. Furthermore, an expert's degree of confidence in the issue at hand can be described using the CF approach. According to the test results, the expert system's 100% accuracy rate and 100% capability for diagnosing disorders in pregnant women operate in accordance with the list of system requirements.

The second study was conducted by Pratama [13]. The goal of the project was to develop an expert system application for Android that used the forward chaining technique. The purpose of this application is to provide information and guidance about pregnancy-related illnesses. This application is intended to serve as a

substitute for speaking with or verifying with a midwife or obstetrician. Adobe Photoshop, StarUML, DIA, JDK, SDK, and Android Studio were used in the development of this application. You can run this application however you choose. According to the test findings, 96% of experts concur that this program can recognize ailments based on the user-selected symptoms and present the relevant remedy.

Sari is the researcher behind the third study. The goal of the study was to develop a conceptual model for the early identification of anxiety and depression symptoms in pregnancy that was based on an expert system. To choose expert system tools, a methodical literature study is the research methodology employed. Additionally, a rule-based expert system is used to create a decision table and generate an algorithm in a screening chart in order to evaluate the symptoms of anxiety and depression during pregnancy. The Edinburgh Postnatal Depression Scale (EPDS) provides good sensitivity and specificity, according to the findings of the systematic literature review. Consequently, the expert system-based mental health screening made use of the EPDS. Seven algorithms were created on a screening chart to identify anxiety and/or depression symptoms in pregnancy in order to incorporate expert knowledge into a computer program. According to the findings, employing EPDS based on an expert system for mental health screening during pregnancy will open up new research possibilities, improve access to health services, and produce reliable and timely results [14].

The fourth study was carried out by Wati. In order to enhance the caliber of midwife examinations, research was done to develop an expert system that uses Forward Chaining to detect pregnant problems. Identification, primary and secondary data collecting, forward chaining data analysis with Bayesian, and evaluation by computing the system success percentage are the techniques employed. Four of the 20 patients in the sample were deemed unsyed since they had only one complaint. 16 patients, meanwhile, filed multiple complaints in compliance with the regulations. About 70% of patients, or 11 out of 16, had valid results between the system and expert or midwife diagnoses. In order for midwives to offer suitable solutions and early treatment in order to lower maternal and infant mortality, it can be said that the system performs well in diagnosing concerns in patients who are in the third trimester of pregnancy [15].

Hatta carried out the fifth study. In order to help women, understand the signs of pregnancy illnesses, this project attempts to develop a WEB-based expert system (ES) that would allow physicians or patients to diagnose pregnancy anywhere. The Bayesian theorem and the forward chaining (FC) approach are used to analyze ES. One method involves building a decision tree, followed by a Bayesian probability calculation and an FC search. With a system accuracy of 82.86% and a system suitability value of 97%, the results of pregnancy problems that have the highest risk of disorders in eclampsia are based on the dataset of selected input symptoms used in 35 patients. In order to determine group clinical outcomes, we further investigated a hybrid of the Bayesian Theorem and FC in a fuzzy-neural network environment, which produced higher accuracy and accuracy values [16].

It is evident from the foregoing statement that the current state of the art in research is that manual detection of pregnancy problems is still the norm. It is currently uncommon to conduct research on the creation of intelligent systems that can identify pregnant issues. Pregnancy complications are still detected by expert systems using traditional techniques like the Bayesian theorem and forward chaining (FC). The Certainty Factor method's drawback is that it requires multiple data processing steps for data larger than two pieces, and its ability to simulate the uncertainty of the computation process is typically still up for question. However, the accuracy attained may drop when using the Bayesian theory and the forward chaining (FC) method. Because the data used has a lot of incorrect values and is constant, there has been a decline. Furthermore, the preprocessing step is skipped by the data used. The goal of the project was to create an application for identifying pregnancy issues based on artificial intelligence. Backpropagation Artificial Neural Network (JST) is the technique employed. In order to develop the backpropagation method, momentum was included. In neural networks, momentum is a weight shift determined by the gradient direction of the preceding and subsequent patterns. In order to speed up the learning process toward convergence, the Artificial Neural Network's momentum parameter was included. Results from experiments have shown demonstrated that this approach can cause the network to converge steadily and rapidly. The suggested research's uniqueness and contribution is this momentum-based backpropagation algorithm. Particularly when it comes to classifying pregnant women into those who are normal and those who are experiencing pregnancy difficulties, intelligent systems will be invaluable.

The stages in the development of intelligent applications for detecting pregnancy complications based on Artificial Intelligence can be explained in Figure 1.

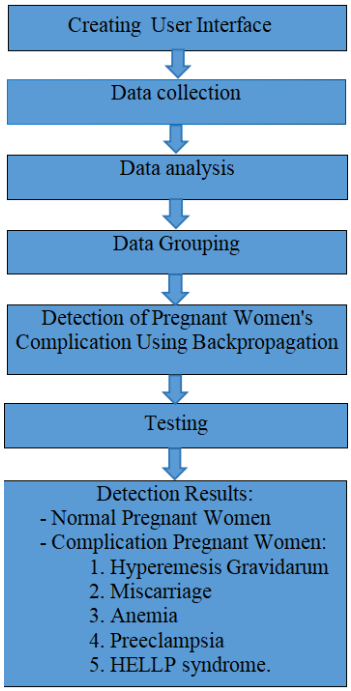

Figure 1: Steps of Proposed Method

Table 1: Types of complication in pregnant women

Disease Codes	Disease Names
P001	Hyperemesis Gravidarum
P002	Miscarriage
P003	Anemia
P004	Preeclampsia
P005	HELLP syndrome

Table 2 contains the symptoms or complaints experienced by pregnant women.

Table 2: Symptoms in pregnant women

Symptom Codes	Symptom Names
S001	Nausea and dizziness
S002	quite severe vomiting
S003	dehydration
S004	difficult to eat or drink
S005	vaginal bleeding
S006	stomach cramps or pain?
S007	body feels weak
S008	fever
S009	tired
S010	dizzy
S011	difficult to concentrate
S012	pale skin
S013	hard to breathe
S014	high blood pressure (hypertension)
S015	urine contains protein
S016	severe headache
S017	visual impairment
S018	heartburn

To make it easier to process backpropagation, a table of the relationship between complication and symptoms was created, as shown in table 3.

Table 3: Relationship between complication and symptoms

Symptoms	Diseases				
	P001	P002	P003	P004	P005
S001	X				X
S002	X				X
S003	X				
S004	X				
S005		X			
S006		X			
S007		X	X	X	
S008		X			
S009			X		X
S010			X	X	
S011			X		
S012			X		
S013			X		
S014				X	
S015				X	
S016				X	X
S017				X	
S018				X	X

The method used to detect complication in pregnant women is backpropagation. This technique uses a multi-layer network with the aim of minimizing errors[12]. Pregnancy complications' symptoms are the input data, and data transformation is the step that converts the symptom data values into a scale of 0 to 1 so that they can be utilized for computations during the Backpropagation training and testing phases.

2.1. Data Collection

Data collecting phases correspond to phases for the analysis, design, and construction of artificial neural network systems. Secondary data from Puskesmas or Posyandu was gathered for this investigation. A hospital physician or midwife has validated the secondary data utilized in this study.

2.2. Stages of Analysis

In order to streamline the application design process, the analysis step involves analyzing the data required for the Backpropagation training and testing phases as well as the requirements of developing applications. Data transformation and input data are included in the data analysis process. The input data consists of symptoms of disorders that affect pregnant women. Data transformation is the process of converting the symptom data into a numerical scale between 0 and 1 so that it can be utilized to calculate the Backpropagation training and testing phases.

2.3. Data Sharing

The data sharing stage is where the data is separated into training and testing data. 70%, 80%, and 90% of the data are used for training, and 30%, 20%, and 10% are used for testing. from the total number of pregnant women.

2.4. Detection of Pregnancy Complications Using Backpropagation

To enable the system to perform training in line with Backpropagation training, the first step of the process involves using the training data that has already been collected. Following training, the final weight will be determined. Testing will be done using this final weight. The following is an explanation of the backpropagation process:

a. Choose a value from a range of 0 to 1 to initialize the initial weights with a small random value. Establish the highest learning rate and era. A maximum epoch of 1000 and a learning rate of 0.1 will be applied in this example of manual computation.
b. Provide input variables (X1 to Xn), which represent pregnancy problems symptoms and their target classes, as training data.
c. There are three stages in the training phase: feedforward propagation, backpropagation, and weight and bias adjustments with the inclusion of momentum parameters. Complete each of the three steps in the computation process.
d. Complete the training procedure as many times as the selected maximum epoch.
e. Following the training phase, the final weight will be saved for use during the testing phase.

2.5. Testing

At this point, the system will be tested using the supplied data. The purpose of this step is to ascertain whether the output generated matches the real data.

2.6. Calculating Accuracy, Sensitivity and Specificity

Should use the Reciever of Characteristic (ROC) approach to evaluate the suggested method's accuracy. by contrasting the generated system's classification findings with the experts' (midwives' or doctors') detection results. The Receiver of Characteristic (ROC) approach will be used to compare the classification findings with the groundtruth (puskesmas midwives), yielding four values: true negative, false positive, false negative, and true positive. A true positive (TP) denotes a normal state that has been accurately classified based on its class. False positives (FPs) are normal statuses that should be accurately classified in their class but are incorrectly identified during the classification process. An aberrant status that is recognized as normal is called a true negative (TN). An abnormal status that is recognized as belonging to the abnormal class is indicated by a false negative (FN). Sensitivity, or the true positive rate (TPR) value, is derived from these four numbers.

III. RESULT AND DISCUSSION

The user must first perform training on the training data before utilizing the generated application. The training menu serves as both a display for conducting the training procedure and a display for inputting the settings of the learning rate, target error, number of hidden layer neurons, momentum, and maximum epoch variables. Figure 2 shows the design of the training display.

Figure 2: Training Menu

The process of detecting pregnancy complications is done by selecting the answer 'Yes' or 'No' on the questionnaire form. Figure 3 shows the process of answering the questionnaire and the detection process and at the same time displays the results.

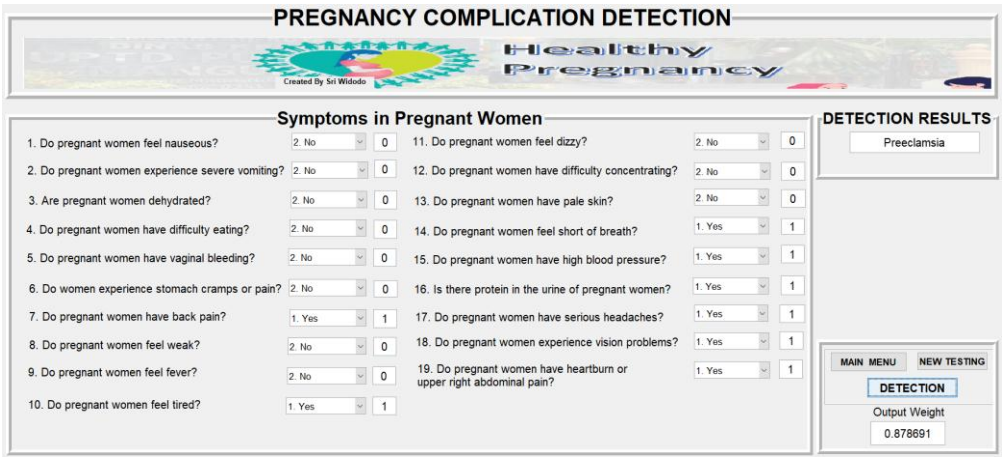

Figure 4: Menu for Filling in the Pregnancy Complication Detection Questionnaire

The accuracy value is the metric used to gauge the model's success rate. Tests employing testing data can be used to estimate accuracy values. There were four runs of the test. With a learning rate of 0.001 and a maximum epoch of 100, the first four tests employed training data of 60:40, 70:30, 80:20, and 90:10, respectively. There are eight buried layer neurons with a target error of 0.01. The backpropagation algorithm can carry out a prediction process, but the resulting value is greatly influenced by determining the parameters of the learning rate and the number of neurons in the hidden layer. There are factors that influence the level of correctness of predictions in a backpropagation neural network, namely learning rate, target error, amount of learning data and weight values assigned randomly to each neuron. A decrease in the learning rate will make the learning process slower.

IV. CONCLUSION

The study's findings suggest that an expert system utilizing the backpropagation method with momentum can function rather effectively, yielding correct results for up to 11 of the 16 patients chosen, or about 70% of the total. In order to prevent mother and newborn deaths prior to the birth process, midwives may use this to view the patient's history of complaints and offer answers and appropriate starting therapy. For further research, additional symptoms and diseases can be carried out, it can also be carried out using other methods that are more current and accurate.

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REFERENCES

[1] Eka. 2013. "Analysis of Comparison of Expert System of Diagnosing Dog Disease by Certainty Factor Method and DempsterShafer Method "Jurusan Teknik Informatika, Fakultas Teknik, universitas Udayana. Bali.

[2] Okezone. 2014. "Maternal mortality rate continues to rise". http://lifestyle.okezone .com/read/2014/12/22/481/1082460/ Indonesia's maternal mortality rate continues to rise. Diakses (27/04/2015 14:22.

[3] Intan Parulian Tiurma Roosleyn, "Strategies to tackle anaemia prevention in pregnancy," J. Ilm. Widya, vol. 3, no. 3, pp. 1–9, 2016.

[4] Y. I. Anitasari and N. E. Widyastuti, "Relationship between midwife K4 coverage and early detection of high-risk pregnancies in Rembang subdistrict" J. Kebidanan, vol. IV, no. 02, pp. 15–25, 2012.

[5] T. Widiastuti, M. I. Kartasurya, and Dharminto, "Management of High-Risk Pregnancy Early Detection on Antenatal Care at Primary Health Care in Jepara District" Manaj. Kesehat. Indones., vol. 02, no. 03, pp. 261–267, 2015.

[6] T. Trisna Beta Kuri Wardani, "Expert System for Diagnosing Pregnancy Complications Using the Web-Based Certainty Factor Forward Chaining Method," J. Mhs. Fak. Sains dan Teknol., vol. 0, no. 0, 2013.

[7] S. Goundrey-SMith, Information Technology in Pharmacy. Springer-Verlag London, 2013.

[8] Brigitta, Rosa, Joko. 2010. " Assistance programme for diagnosing pregnancy health problems using forward chaining method "jurusan Teknik Informatika, Fakultas Teknik. Universitas kristen duta wacana. Yogyakarta.

[9] Suci. 2014. " Expert System for Early Prevention of Cervical Cancer Based on Risk Factors Using the Certainty Factor Method "Jurusan Ilmu Komputer, Program studi informatika dan ilmu komputer, universitas Brawijaya. Malang.

[10] Effendi, H. (2020). Expert System for Diagnosing Diseases in Pregnant Women. Teknomatika, 10(01), 9–20. http://ojs.palcomtech.com/index.php/teknomat ika/article/view/482

[11] Lubis, A. (2016). Case-based Pregnancy Disease Consultation Expert System Using Case Based Reasoning (CBR) Method. Riau Journal of Computer Science, 2(1), 66–75

[12] Aryu Hanifah Aji, M. Tanzil Furqon, Agus Wahyu Widodo, Expert System for Diagnosing Diseases of Pregnant Women Using the Certainty Factor (CF) Method, Jurnal Pengembangan Teknologi Informasi dan Ilmu Komputer,Vol. 2, No. 5, Mei 2018, hlm. 2127-2134.

[13] Gusti Putu Rudi Pratama, Kemal Ade Sekarwati dan Romdhoni Susiloatmadja, Expert System Application for Identifying Diseases in Pregnant Women with Android-Based Forward Chaining Method, Jurnal Format Volume 9 Nomor 2 Tahun 2020.

[14] Sari N. D., Kemal N. Siregar, Hadi Pratomo, Expert System Conceptual Model from Systematic Literature Review: Mental Health Screening in Pregnancy During the COVID-19 Pandemic, Women, Midwives and Midwifery Journal: Volume 2, Issue 3, 2022.

[15] Wati E. F., Anggi Puspitasari, Expert System for Diagnosing Pregnancy Complaints by Forward Chaining, Sinkron: Jurnal dan Penelitian Teknik Informatika, Volume 5, Number 1, October, 2020.

[16] Hatta H. R., Fitria Ulfah, Dyna Marisa Khairina, Hamdani Hamdani, Septya Maharani, Web-Expert System for The Detection Of Early Symptoms Of The Disorder Of Pregnancy Using A Forward Chaining And Bayesian Method, Journal of Theoretical and Applied Information Technology, 15th June 2017. Vol.95. No 11.

[17] Haykin, S. (2009) Neural Networks and Learning Machines. Prentice Hall/Pearson, New York.

[18] Puspita, A. & Eunike. 2007. Use of Artificial Neural Network Backpropagation Method to Predict Cleft Lip. Seminar NasionalTeknologi.

[19] Siang, J.J. 2009. Artificial Neural Networks and Programming Using MATLAB. Yogyakarta: ANDI.