Proceeding International Joint Conference on Science and Technology (IJCST) 2017

ISBN : 978-602-99806-3-9

Modeled early detection of pregnancy risk based on Poedji Rochjati score card using relief and neural network

Fetty Tri Anggraeny*, Faisal Muttaqin and M. Syahrul Munir
Faculty of Computer Science Universitas Pembangunan Nasional "Veteran" Jawa Timur, Indonesia

Abstract. The safety and healthy of pregnant women and their babies is very important. An anticipatory action should be prepared as early as possible to prevent or reduce the high risk of pregnancy. The Poedji Rochjati Score Card (PRSC) is one of the methods that can be used to know the pregnancy risk used by doctors and midwives. This research proposed modeling PRSC using artificial neural network (ANN) method and select the most important factor in determining the pregnancy risks using ReliefF algorithm. The results of early pregnancy risk detection using ANN is expected to assist the process of checking the risk of pregnancy, either by pregnant women or by health workers. Experiment show that the best configuration was using 4 neighborhood parameter of ReliefF algorithm and 5 hidden neuron parameter of Neural Network. And the significant feature are bleeding during pregnancy, baby dies in uterus, never failed pregnancy, had caesarean section, too late pregnant, first pregnancy when age 35th, age<= 16th, too soon pregnant again, diabetes, blood deficiency, had given birth and was given infusion / transfusion, age> = 35th, pregnant twins 2 or more.

Keywords: pregnancy risk, Poedji Rochjati Score Card, ReliefF, neural network.

1. INTRODUCTION

The meaning of pregnancy according to Astuti Maya is the time when a woman carries an embryo or fetus in her body. Early pregnancy occurs when the female ovum breaks off and enters the ovarium [1]. Maternal health is very influential on fetus growth. In addition, good maternal health during pregnancy is also helpful when it comes time to give birth and also breastfeeding newborns. Maternal health influenced by several factors such as age, education, psychological, nutritional knowledge and activities.

Based on the data from Indonesian Demographic and Health Survey (SDKI) in 2012 [2], the maternal mortality ratio in 1997 was 390 deaths per 100,000 live births, in SDKI 2002-2003 was 307 deaths per 100,000 live births, and in the SDKI 2007 was 228 deaths per 100,000 births live. However, this number figure increases in the SDKI 2012 became 359 deaths per 100,000 live births. While infant mortality rate was less than 6 days decreased according to survey results of 2002, 2007, and 2012 are 23, 20, and 19 from 1,000 births.

Based on these data, pregnant mother should conduct a series of periodic health checks to determine the condition of pregnancy and fetal health. Early screening tools/early detection of pregnant women's risk are Poedji Rochjati Score Card (PRSC). The scorecard format is structured in a combination format between checklist and score system. Score is the approximate weight of the pregnant risk [3]. In this PRSC, there are 26 parameters that must be filled by health worker based on the pregnant women

ISBN : 978-602-99806-3-9

condition. Maybe there are consist of primer parameter or non-primer parameter, so we can find the primer parameter first before we modelled the data into a machine learning.

In order to find primer parameter of data, we can use a feature selection method. Feature selection is one of the most frequent and important techniques in data preprocessing, and has become an indispensable component of the machine learning process [4]. It is the process of detecting relevant features and removing irrelevant, redundant, or noisy data. This process speeds up data mining algorithms, improves predictive accuracy, and increases comprehensibility. Irrelevant features are those that provide no useful information, and redundant features provide no more information than the currently selected features [5].

Based on the above description, in this research will be modeled an application of early detection of pregnancy risk based on Poedji Rochjati Score Card to find out the most influential pregnancy factor in pregnancy health. In addition, this application can help pregnant women and health workers to know the risks of early pregnancy.

2. METHODS

In this research will be applied 2 methods, namely ReliefF feature selection and Neural Network classification. Methodology stages in this study can be seen in figure 1.

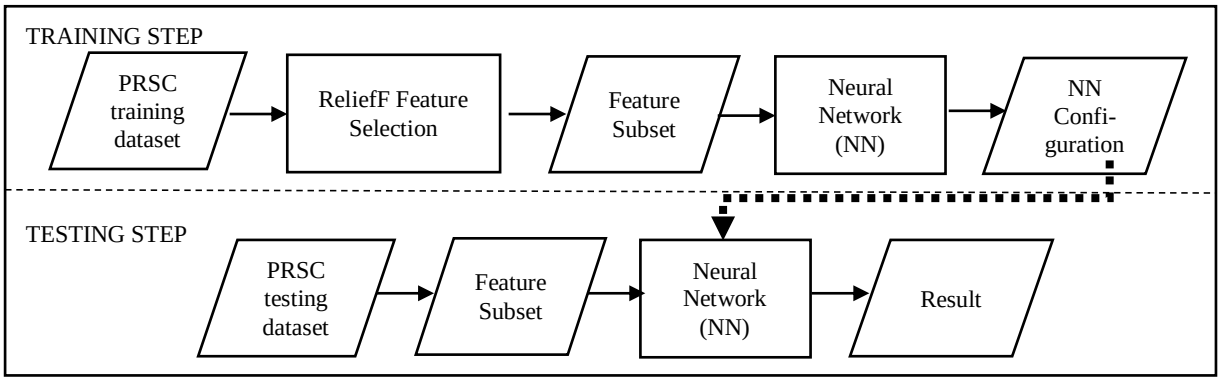

Fig. 1 Proposed Method.

Neural network is a supervised learning machine, which requires the training stage to get the configuration according to the problem. As shown in the flowchart training Figure 1, the result of the training process is a neural network configuration consisting of the number of hidden nodes and the weights between neurons.

After the training process, the neural network can be used for the testing process. The direct dataset testing feature uses the best feature subset number obtained from the training stage. And then put into neural network result of training process.

2.1 Poedji Rochjati Score Card

According to Poedji Rochjati [3], risk is a statistical measure of the probability or possibility of occurrence of an undesirable emergency situation in the future, namely the possibility of obstetric complications at the time of delivery which may cause death, sickness, disability, discomfort or dissatisfaction in the mother and/or baby. Poedji Rochjati Score Card is a method for introducing/early detection of pregnancy risk factors. This tool was made in 1989 for the mother of PKK (at that time there was no midwife in the village), in Sidoarjo district. With the concept of “dasa-wisma”, PKK agent can soon find her neighbor's pregnant woman [3].

In modern obstetrics there is a potential risk awareness, in which a pregnancy and childbirth always have a risk with the possible danger/risk of complications in the process of giving birth. This requires proactive anticipatory prevention efforts since the beginning of pregnancy, during pregnancy until the time of delivery performed by health workers, midwives in the village with pregnant women, husbands,

ISBN : 978-602-99806-3-9

families, and communities. The objective of the Risk Approach is to improve the quality of care for all pregnant women, fetuses and newborns as a whole, and special and more intensive attention is given to those who have greater likelihood of rescue [3]. In supporting the success of the objectives of the Risk Approach, there should be an extension about the condition of pregnant women in the form of Information and Education Communication to pregnant women, husbands, families and communities.

The level of risk can be formed of numbers called scores. Score is the approximate weight of the pregnant risk. The number of scores will provide an understanding of the level of risk faced by pregnant women. The type of pregnancy risk of pregnant women is obtained from the sum of scores of problems or risk factors experienced by pregnant women. Based on the number of scores, the risk of pregnancy is divided into three groups, namely:

1. Low Risk Pregnancy (KRR): Total Score 2
2. High Risk Pregnancy (KRT): Number of Scores 6-10
3. Very High Risk Pregnancy (KRST): Total Score ≥12

2.2 Feature Selection

Feature selection is divided into two approaches, namely the wrapper approaches and filter approaches [6]. Filter approach of feature selection is done separately with classification engine, or in other words, the selection of features is used as a data preprocessing before it is input into the classification engine. Some methods of filter approach of feature selection are gain ratio [6, 7], particle swarm intelligence (PSO) [8, 9], differential evolution [10], biclass adaptive discriminant ratio [11], reliefF [12, 13, 14].

Wrapper approach use classification engine to be trained and tested with feature set, if the addition feature make the accuracy decrease, then it will be remove from feature set. At the other hand, , if the addition feature make the accuracy increase, then it will be stay in feature set. The engine will process feature set and not use the other feature that will weaken the accuracy of the system. For example some methods in this approach are Ant Colony Optimization (ACO) [15], Sequential Forward Floating Selection (SFFS) [16], etc.

Based on this description, it appears that the filter approach is much simpler than the filter wrapper approach. In addition, the time required to filter approach is faster than the wrapper approach. But by using a wrapper approach, the classification engine will be optimized based on the features.

2.2.1Relieff Feature Selection

ReliefF [12] is a classical feature selection algorithm. It utilizes the correlation between the characteristics to make similar samples close and keep heterogeneous samples apart in order to achieve the purpose of the feature selection. ReliefF algorithm is the development of Relief algorithm that is not able to overcome inclomplete data and only limited to 2 class problem only. ReliefF algorithm is made to solve the problems that can not be overcome by Relief algorithm.

ReliefF algorithm is used to solve single label problem [13]. Assume that there are n instances and L labels. Let $P \in R^f$ be the full set of features, $p \in P$ be a feature, $X=[x_1, x_2, \ldots, x_n] \in R^{n \times f}$ denote instances and let $Y=[y_1, y_2, \ldots, y_n] \in R^{n \times L}$ denote the instances with labels. One instance represented by $x_i \in R^f$ can be expressed as $x_i=[p_i^1, p_i^2, \ldots, p_i^f]$. It is associated with a set of labels by a binary vector $y_i=\{0,1\}^l$, and $y_i(l)=1$ if x_i belongs to the l th class and $y_i(l)=0$ otherwise. Since an instance owns multiple labels, $\sum y_i(l) \geq 1$.

For the classical ReliefF[12], the algorithm samples m instances randomly from the dataset. For each sample point x_t ($1 \leq t \leq n$), it finds K nearest neighbors that belongs to the same class$C$ as x_t named as Hit and for other (L–1) classes (other than C), it also finds K nearest neighbors denoted as Miss (C); So the formula for updating every feature is computed as,

$$W_P = W_P - \sum_{j=1}^{K} \frac{d(p,x_t,H_j)}{m \cdot K} + \sum_{C \neq C(x_t)} \sum_{j=1}^{K} \frac{P(C)}{1-P(C(x_t))} \cdot \frac{d(p,x_t,M_j)}{m \cdot K} \qquad (1)$$

ISBN : 978-602-99806-3-9

Where W_P denotes the value of feature p, $P(C)$ is the priori probability of the label class C, and $d(p, x_t, x_j)$ is the distance between x_t and x_j on feature p (usually the Euclidian distance).

2.3 Neural Network

Artificial Neural Networks are one of the artificial representations of the human brain that simulate the learning process in the human brain. The term artificial is used because this neural network is implemented by using a computer program capable of completing a number of calculation processes during the learning process [17]. The human brain contains millions of nerve cells in charge of processing information. Every nerve cell (neurons) will have a single cell nucleus, the nucleus of this cell that will be in charge of processing information. For example when our skin is exposed to heat, then the information received by the nerve cells in the skin will be forwarded to the brain for processing, after it is channeled back to the nerve cells to produce motion reflex motion. Similarly, the artificial neural network algorithm, consisting of many interconnected neurons to process input data into output data. Adopting nerve cells (neurons) in humans, where each neuron has a cell nucleus, functions as information processing, and synapses, which act as interconnects between neurons and also as input receivers and produce output. Adoption of artificial neural network cells to human nerve cells can be seen in figure 2.

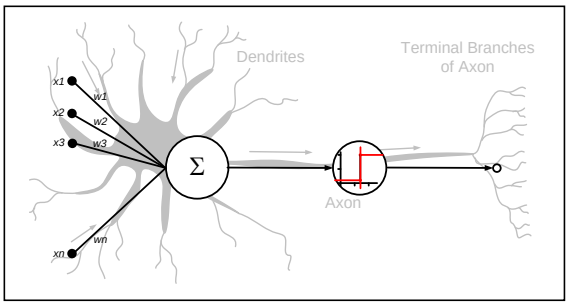

Fig. 2 Human nerve cell adopted to artificial neural network nerve cell.

Components of artificial neural networks as follows:

1. Neurons, nerve cells that will transform information received through its outgoing connection to other neurons. Within each neuron there is an activation function to replace the electrochemical process.
2. Weight, in artificial neural networks, the relationship between neurons known as the weights that replace the function of synapses.

In neural networks, neurons will be collected in layers called neuron layers (neuron layers). Information provided on the neural network will be propagated layer to layer, from input to output layer through another layer, known as a hidden layer. Depending on the learning algorithm, the information may be retroactively retrieved on the network. The artificial neural network method employed is backpropagation which is a controlled learning algorithm with multiple layers to change the weights associated with neurons present in the hidden layer (see figure 3). The learning method of the neural network is called supervised if the expected output has been known before.

ISBN : 978-602-99806-3-9

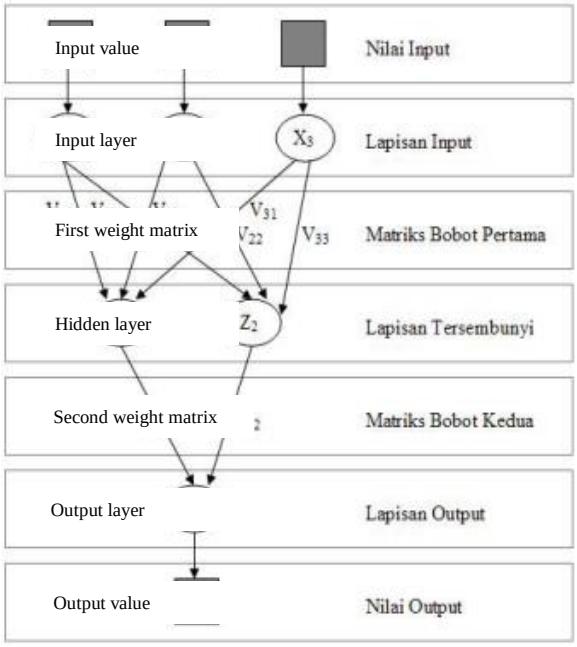

Fig. 3 Multilayer perceptron architecture

3. RESULT AND DISCUSSION

First, the dataset was applied by feature selection algorithm, ReliefF. The number of neighborhood parameter of ReliefF algorithm is variant start from 2 to 10. Table 1 show ReliefF feature selection result, bold number in atribut ranking column indicate feature number that have positif ranking value. And the number with underline is the feature number that occur in all experiment variant number of neighborhood, there are feature number 2, 3, 12, 13, 14, 23, and 27.

After feature selection, we classify the subset feature (bold feature number) using neural network. Table 2 show neural network classification performance using RMSE value. The last row is the result using the underlined features. And the bold number indicate the best configuration of neural network. First column, feature subset has the same meaning with first column on Table 1, number of neighborhood. Experiment result on Table 2, show that the best configuration using 4 neighborhood parameter of ReliefF algorithm and 5 hidden neuron parameter of Neural Network.

Table 1 Relieff fitur selection with varians neighborhood value (K).

Number of Neighborhood	Atribut Ranking
2	27,23,3,7,14,4,2,18,13,16,12,9,21,10,11,28,15,25,26,17,24,1,22,19,5,6,8,20
3	27,23,3,2,9,13,1,14,7,21,4,12,16,20,18,26,24,25,10,19,22,17,15,28,11,6,8,5
4	27,23,9,13,2,3,1,4,18,14,12,7,21,16,20,25,19,26,24,22,28,17,15,11,10,5,6,8
5	27,13,23,3,7,9,1,2,18,16,12,21,14,20,4,25,15,17,26,24,28,22,11,19,10,5,6,8
6	27,13,1,9,3,23,2,12,14,16,20,18,21,7,19,25,26,24,10,11,15,17,28,22,4,5,6,8
7	27,13,3,23,12,9,2,1,7,16,18,14,20,21,25,17,15,26,24,28,22,19,10,11,6,4,5,8
8	27,13,3,9,7,23,12,2,1,16,18,14,20,25,24,17,22,26,15,28,10,19,11,21,6,4,8,5
9	27,13,3,9,23,7,12,16,2,1,18,14,20,25,24,17,22,26,15,28,10,19,11,21,6,8,4,5
10	27,13,3,7,9,12,23,2,16,18,1,14,20,25,24,17,22,26,15,28,10,19,11,6,21,8,5,4

ISBN : 978-602-99806-3-9

Table 2 RMSE value of neural network classification using feature subset.

Feature Subset	Number of hidden neuron							
	5	10	15	20	25	30	35	40
2	0,23	0,770	0,226	~	0,228	0,2281	0,228	0,229
3	0,222	~	0,201	~	~	0,204	0,206	0,207
4	0	~	0,003	~	~	0,005	0,454	0,358
5	0,225	~	0,191	~	0,199	0,196	0,203	~
6	0,289	~	0,401	0,255	0,260	0,261	12,375	9284,6
7	0,267	~	0,276	0,956	0,255	0,259	0,264	0,264
8	0,271	2,05	0,264	0,606	~	0,251	0,259	0,259
9	0,267	~	0,276	0,956	0,255	0,259	0,264	0,264
10	0,285	~	0,264	0,973	~	0,254	0,278	0,262
a*	0,3261	0,402	0,3071	0,3059	1,5769	~	0,288	0,2912

* is subset feature that consist of number feature that occur in all variant neighborhood.
~ is infinity value

4. CONCLUSION

Experiment show that the best configuration was using 4 neighborhood parameter of ReliefF algorithm and 5 hidden neuron parameter of Neural Network. And most significant feature are And the significant feature are bleeding during pregnancy, baby dies in uterus, never failed pregnancy, had caesarean section, too late pregnant, first pregnancy when age 35^{th}, age$\leq 16^{th}$, too soon pregnant again, diabetes, blood deficiency, had given birth and was given infusion / transfusion, age$\geq 35^{th}$, pregnant twins 2 or more.

Modeled application of early detection of pregnancy risk based on Poedji Rochjati Score Card can be used for pregnant woman, doctor or midwife as an assistant for early detection of pregnancy risk. In this research focus on method test, and the result is very good with 0 value of RMSE. This model can be implemented on mobile application, so it can help more and easy for pregnant woman.

5. REFERENCES

[1] Astuti, M., Smart Pregnancy Book. Jakarta: EGC, 2010.
[2] Badan Pusat Statistik, Indonesia Demographic and Health Survey 2012. Indonesia, 2013.
[3] Rochjati P., Antenatal Screening In Pregnant Women Edition 2, Airlangga University Press, Surabaya, 2011.
[4] Kalousis, J. Prados and M. Hilario, Stability of Feature Selection Algorithms: A Study on High Dimensional Spaces, Knowledge and Information System, Vol. 12, No. 1, 2007, pp. 95-116.
[5] Kumar V. and Minz S., Feature Selection: A Literature Review, Smart Computing Review, Vol. 4, No. 3, June 2014.
[6] Karegowda A.G., Manjunath A.S. and Jayaram, M.A., Comparative Study of Attribute Selection using Gain Ratio and Correlation based Feature Selection, International Journal of Information Technology and Knowledge Management, Vol. 2, No.2, 2010, pp.271-277.
[7] Anggraeny F.T. and Widiasri M., Voting of Artificial Neural Network Particle Swarm Optimization Biclassifier using Gain Ratio Feature Selection, Kursor, Vol.7, No.2, 2013.
[8] Huang C.L. and Dun J.F., A Distributed PSO–SVM Hybrid System with Feature Selection and Parameter Optimization, Applied soft Computing, Vol.8, No.4, 2008, pp.1381-1391.
[9] Yang H.C., Zhang S.B., Deng K.Z. and DU P.J., Research Into a Feature Selection Method for Hyperspectral Imagery using PSO and SVM, Journal of China University of Mining and Technology, Vol.17, No.4, 2007, pp.473-478.

ISBN : 978-602-99806-3-9

[10] Khushaba R.N., Al-Ani A. and Al-Jumaily A., Feature Subset Selection using Differential Evolution and A Statistical Repair Mechanism, Expert Systems with Applications, Vol.38, No.9, 2011, pp.11515-11526.

[11] Anggraeny F.T. and Indriati H.R.H., Voting of Biclass and Multiclass Artificial Neural Network, Proceedings of Bali International Seminar on Science and Technology 2011.

[12] Kononenko I., Estimating Attributes: Analysis and Extensions of RELIEF, In European Conference on Machine Learning, Springer Berlin Heidelberg, April 1994, pp. 171-182.

[13] Cai Y., Yang M. and Yin H., Relieff-Based Multi-Label Feature Selection, International Journal of Database Theory and Application, Vol.8, No.4, 2015, pp.307-318.

[14] Durgabai R., Feature Selection using ReliefF Algorithm, International Journal of Advanced Research in Computer and Communication Engineering, Vol. 3, Issue 10, 2014.

[15] Liao T.W., Feature Extraction and Selection from Acoustic Emission Signals with An Application in Grinding Wheel Condition Monitoring, Engineering Applications of Artificial Intelligence, Vol.23, No.1, 2010, pp.74-84.

[16] Bouckaert R. R., Frank E., Hall M., Kirby R., Reutemann P., Seewald A., and Scuse, D., WEKA Manual for Version 3-6-9, 2013.

[17] Hermawan A., Artificial Neural Network Theory and Applications, ANDI Yogyakarta, 2006.