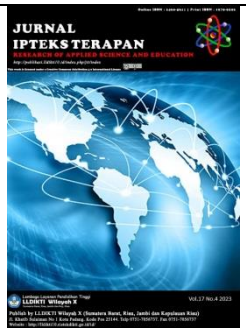

Vol. 17 No.4 2023

IMPLEMENTATION OF THE ROUGH SET METHOD WITH A DEEP LEARNING APPROACH IN THE PROCESS OF DIAGNOSING OTITIS DISEASE

Irzal Arief Wisky*[1], Teri Ade Putra[2]
[12]Universitas Putra Indonesia YPTK Padang
*Corresponding Email: irzal.arief12@gmail.com

Submit :
12/06/2023

Accept :
23/11/2023

Publish :
01/12/2023

Abstract

Early research was motivated by the increasing rate of spread of otitis, where otitis is a common health disorder of the human ear and often requires rapid and accurate diagnosis. This problem requires deep learning by applying a method in the computer field to provide performance in classification. This research aims to develop an analysis model using a Deep Learning (DL) approach in diagnosing otitis. The method used in this development involves the performance of the Rough Set (RS) and Artificial Neural Network (ANN) methods to provide optimal analysis output. The research dataset refers to the clinical diagnosis of otitis patients which consists of 3 types, namely acute, effusion and chronic. The test results of the analysis model developed using the DL approach were able to provide quite good output with an accuracy level of 99%. These results are based on the analysis patterns obtained based on the performance of the RS method. Based on these results, it can be concluded that the analytical model developed provides maximum and better results compared to the previous model based on the output and presentation of a systematic process in the classification of otitis disease.

Keywords: Otitis Disease, Health Disorders, Deep Learning, Classification Of Diseases, Decision Tree.

http://publikasi.lldikti10.id/index.php/jit DOI : https://doi.org/10.22216/jit.v17i4.2574 PAGE 756-762

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Research of Applied Science and Education V17.i4 (756-762)

ISSN : 1979-9292

E-ISSN : 2460-5611

INTRODUCTION

Otitis, often known as ear infection, is a common health problem throughout the world, especially in children [1], [2]. Otitis can cause pain, hearing loss, and even serious complications if not treated appropriately [3]. Therefore, fast and accurate diagnosis is very important in treating this disease. In an effort to improve the quality of otitis diagnosis, the use of the latest technology such as Deep Learning is able to provide improvements in the diagnosis process [4]. Deep Learning has been proven effective in various medical applications including disease diagnosis. Its main advantage is its ability to process complex data and extract patterns that are difficult for humans to recognize [5]. DL is basically capable of carrying out classification to produce information and knowledge [6]. Based on previous research, it is clear that the performance of deep learning in the identification process provides output with average values of accuracy, precision and recall of 91.71%, 91.25% and 92.65% respectively [7]. However, to achieve an optimal level of diagnostic accuracy, additional efforts are needed such as using the Rough Set method to present precise and accurate analysis patterns. The Rough Set method is basically an important tool in data analysis which is used to identify relevant features in a dataset [6]. This method has the advantage of overcoming uncertainty in medical data which is often incomplete and vague [8]. Deep Learning combined with the performance of the Rough Set method is able to provide improved diagnosis results [9]. Its application in diagnosis can provide information in medical decision making and improve diagnosis results [10]. Another approach that will also be explored in this research is the use of Artificial Neural Networks (ANN) and Decision Trees [11]. ANN has been proven successful in various medical applications, while Decision Tree is a simple but effective method for making decisions based on clear rules [12]. Artificial Neural Network (ANN) is a popular method in the DL concept and is used in solve problems by learning on a network [13]. ANN provides results by presenting a fairly high level of accuracy. ANN is also used in problem solving analysis to produce better classification models [14]. Apart from the ANN method in classification analysis, the Decision Tree (DT) method is also used to provide an overview of the results of classification analysis in the form of a decision tree [15]. The results of DT analysis can be used in decision making based on the resulting knowledge base. DT performance can be developed in a structured classification model to provide optimal analysis results [16]. This research provides a new analytical model. The novelty of this research is presented in the optimized DL performance with the RS approach to present classification rule patterns. The resulting classification rule is also equipped with a certainty level (CF) value based on facts and knowledge of symptom data for the type of otitis disease. The analysis output using the DL concept is expected to provide optimal results in classification. Overall, this study will present a much better analytical model than previous models for classifying otitis disease. With this research, the analysis results obtained can provide new

JURNAL IPTEKS TERAPAN
Research of Applied Science and Education V17.i4 (756-762)

ISSN : 1979-9292

E-ISSN : 2460-5611

knowledge in the form of a knowledge-based system that can be used as a basis for decision making.

RESEARCH METHODS

The research stage is a stage in research that is carried out in a structured and systematic manner which is divided into four parts, according to the system design in Figure 1,

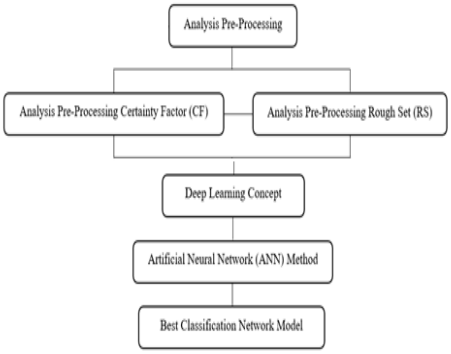

Figure 1. Research Design

1. The first part is pre-processing analysis, which consists of two stages, namely pre-processing certainty factor (CF) analysis and pre-processing rough set (RS) analysis
2. The second part is the deep learning concept, namely the process of creating a more powerful deep learning model, resulting in techniques that can reduce learning speed, transfer speed, and initial training.
3. The third part is the artificial neural network (ANN) method, which detects classification results clearly so that the results displayed are more accurate and relevant.

The fourth part is the best classification network model, namely evaluating the performance of the model in classifying otitis disease.

Analysis Pre-Processing

The analysis carried out at the beginning is to determine indicators in the classification process. The indicators used are data on symptoms and types of otitis disease. Data obtained from experts stored at M. Djamil Hospital, Padang City, West Sumatra, Indonesia. Otitis disease consists of 3 types: acute otitis (P1), effusion otitis (P2), and chronic otitis (P3). The pre_processing process can be carried out using the Certainty Factor (CF) concept. CF is a concept used to provide a level of confidence. The results of pre-processing analysis using CF can be seen in Table 1.

Sakit telinga	Mudah Marah	Gangguan tidur	Demam tinggi	Kehilangan Keseimbangan	Gangguan pendengaran	Mual	Sakit kepala	Diare	Nafsu Makan Berkurang	Penyakit
Ya	Ya	TIDAK	Ya	TIDAK	TIDAK	TIDAK	TIDAK	TIDAK	TIDAK	Otitis akut = 0,6
TIDAK	Ya	Ya	Ya	TIDAK	TIDAK	TIDAK	TIDAK	TIDAK	Ya	Otitis akut = 0,8
Ya	Ya	Ya	Ya	TIDAK	TIDAK	TIDAK	Ya	Ya	Ya	Otitis akut = 1,0
TIDAK	Ya	Ya	Ya	TIDAK	TIDAK	TIDAK	TIDAK	Ya	TIDAK	Efusi Otitis (0.6)
Ya	Ya	Ya	Ya	Ya	TIDAK	TIDAK	TIDAK	Ya	Ya	Efusi Otitis (0.8)
Ya	Ya	Ya	Ya	Ya	Ya	TIDAK	Ya	Ya	Ya	Efusi Otitis (1.0)
TIDAK	TIDAK	TIDAK	TIDAK	Ya	Ya	TIDAK	TIDAK	TIDAK	TIDAK	Otitis kronis (0,6)
TIDAK	TIDAK	TIDAK	Ya	Ya	Ya	TIDAK	TIDAK	Ya	TIDAK	Otitis kronis (0,6)
TIDAK	Ya	TIDAK	Ya	Ya	Ya	TIDAK	TIDAK	Ya	TIDAK	Otitis kronis (0,8)
TIDAK	Ya	TIDAK	Ya	Ya	Ya	Ya	TIDAK	Ya	TIDAK	Otitis kronis (1.0)

Table 1. Analysis Pre-Processing With CF

Table 1 explains that the pre-processing results using CF provide a confidence level for the type of Otitis disease consisting of 0.6 (Possible), 0.8 (Almost Certain), and 1.0 (Definite). This certainty value is used to produce new knowledge that will be developed in the next pre-processing stage using the Rough Set (RS) method. RS can provide patterns based on the grouping of data classes used. In another case, RS is also a concept applied in the case of information-based classification. The results of the

JURNAL IPTEKS TERAPAN
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ISSN : 1979-9292

E-ISSN : 2460-5611

presentation of the RS analysis process provide a major contribution to the classification process. The sample output carried out by the hospital can be seen in Table 2.

Sakit telinga	Mudah Marah	Gangguan tidur	Demam tinggi	Kehilangan Keseimbangan	Gangguan pendengaran	Mual	Sakit kepala	Diare	Nafsu Makan	Penyakit
TIDAK	Ya	TIDAK	Ya	TIDAK	TIDAK	TIDAK	TIDAK	TIDAK	TIDAK	Otitis akut (0.6)
TIDAK	Ya	TIDAK	Ya	TIDAK	TIDAK	TIDAK	TIDAK	TIDAK	Ya	Otitis akut (0.8)
TIDAK	Ya	TIDAK	Ya	TIDAK	TIDAK	TIDAK	TIDAK	Ya	Ya	Otitis akut (1.0)
TIDAK	Ya	TIDAK	Ya	TIDAK	TIDAK	TIDAK	TIDAK	Ya	TIDAK	Efusi Otitis (0.6)
TIDAK	Ya	TIDAK	Ya	Ya	TIDAK	TIDAK	TIDAK	Ya	Ya	Efusi Otitis (0.8)
TIDAK	Ya	TIDAK	Ya	Ya	Ya	TIDAK	TIDAK	Ya	Ya	Efusi Otitis (1.0)
TIDAK	TIDAK	TIDAK	Ya	Ya	Ya	TIDAK	TIDAK	TIDAK	TIDAK	Otitis kronis (0.6)
TIDAK	TIDAK	TIDAK	Ya	Ya	Ya	TIDAK	TIDAK	Ya	TIDAK	Otitis kronis (0.8)
TIDAK	Ya	TIDAK	Ya	Ya	Ya	TIDAK	TIDAK	Ya	TIDAK	Otitis kronis (0.8)
TIDAK	Ya	TIDAK	Ya	Ya	Ya	Ya	TIDAK	Ya	TIDAK	Otitis kronis (1.0)
TIDAK	Ya	TIDAK	Ya	TIDAK	TIDAK	TIDAK	TIDAK	TIDAK	TIDAK	Otitis akut (0.6)
TIDAK	Ya	TIDAK	Ya	TIDAK	TIDAK	TIDAK	TIDAK	TIDAK	Ya	Otitis akut (0.8)
TIDAK	Ya	Ya	Ya	Ya	TIDAK	TIDAK	TIDAK	Ya	Ya	Otitis akut (1.0)
TIDAK	Ya	Ya	Ya	TIDAK	TIDAK	TIDAK	TIDAK	TIDAK	TIDAK	Efusi Otitis (0.6)
TIDAK	Ya	Ya	Ya	Ya	TIDAK	TIDAK	TIDAK	TIDAK	Ya	Efusi Otitis (0.8)
TIDAK	Ya	Ya	Ya	Ya	TIDAK	TIDAK	TIDAK	TIDAK	Ya	Efusi Otitis (1.0)
TIDAK	TIDAK	TIDAK	Ya	Ya	TIDAK	TIDAK	TIDAK	TIDAK	TIDAK	Otitis kronis (0.6)
TIDAK	Ya	TIDAK	Ya	Ya	TIDAK	TIDAK	TIDAK	TIDAK	TIDAK	Otitis kronis (0.8)
TIDAK	Ya	TIDAK	Ya	Ya	TIDAK	Ya	TIDAK	TIDAK	TIDAK	Otitis kronis (1.0)

Table 2. Analysis Pre-Processing With Rough Set

Table 2 is the pre-processing results produced by the hospital to present patterns in classification. In the process, RS provides a classification pattern of 106 rules. This pattern can become new knowledge in the classification process to provide maximum results. With the pattern results resulting from pre-processing analysis based on the CF concept and the RS method, it can be used to carry out the otitis disease classification process.

Deep Learning Concept

Deep Learning (DL) Is a broad learning concept developed for specific purposes. DL can represent knowledge with a fairly large data model. This concept is used to produce solutions based on given data-based learning and results that provide a fairly minimal error rate.

Artificial Neural Network (ANN)

Artificial Neural Network (ANN) was implemented in classification analysis and presented quite good results. Classification analysis was developed using a learning model with precise and accurate results.

Best results based on the results of the network training and testing process. Classification analysis with the ANN concept adopts learning with a feedforward algorithm to provide optimal results. The ANN architecture is depicted as in Figure 2.

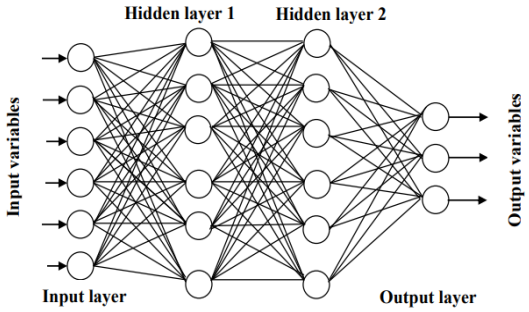

Figure 2. Architecture ANN

Figure 2 explains that the ANN architecture visualization model has 3 layers, including the input layer, hidden layer, and output layer. The architectural model can be redeveloped with a multilayer model of hidden layers used. The ANN concept is a learning method that adopts human intelligence. This, the ANN concept can be developed in the analysis of otitis disease classification to provide the best results.

RESULT AND DISCUSSION

This research classifies Otitis disease which begins with learning using the concept of Deep Learning (DL). DL development has been widely used in case classification to produce good results. DL can provide a precise and accurate learning process in solving classification problems. To carry out the learning process, the Artificial Neural Network (ANN) method can be used to classify Otitis disease. The ANN learning process

JURNAL IPTEKS TERAPAN
Research of Applied Science and Education V17.i4 (756-762)

ISSN : 1979-9292

E-ISSN : 2460-5611

in the classification process will begin with training and testing. The results of the training and testing carried out can be seen in table 3.

Arsitektur	Pelatihan					Pengujian				
	Ketepata	UMK	Gradien	Sensitivita	Validasi	Ketepata	UMK	Gradien	Sensitivita	Validasi
Lapisan Tersembunyi Tunggal										
(5-3-1)	99.7037	0,2963	0.0003	0.9654	0.8977	99.9919	0,008	0.0034	0.9359	0.9655
(5-7-1)	99.9859	0.0141	0.0214	0.9589	0.9263	99.9851	0,014	0.0006	0.9537	0.9829
(5-13-1)	99.9868	0.0132	0.0004	0.9678	0.7849	99.9841	0,015	0.0013	0.9743	0.8814
(5-17-1)	99.9756	0.0244	0.0009	0.8320	0.8410	99.9896	0,010	0.0004	0.9460	0.9417
(5-20-1)	99.9787	0.0213	0.0003	0.9794	0.8759	99.9840	0,016	0.0001	0.9609	0.9646
Multi Lapisan Tersembunyi										
(10-5-5-2)	99.9831	0.0169	0.0114	0.9540	0.8689	99.9948	0,005	0.0011	0.9632	0.8399
(10-10-5-2)	99.9799	0.0201	0.0006	0.9699	0.8688	99.9958	0,004	0.0002	0.9768	0.8733
(10-10-10-2)	99.9846	0.0154	0.0008	0.9813	0.9210	99.9890	0,011	0.0003	0.9634	0.9735
(10-5-5-5-2)	99.9702	0.0298	0.0037	0.8916	0.8484	99.9840	0,016	0.0112	0.9694	0.8917
(10-10-5-5-2)	99.9886	0.0114	0.0017	0.9742	0.9353	99.9948	0,005	0.0018	0.9532	0.9914
(10-10-10-5-2)	99.9852	0.0148	0.0002	0.9836	0.8126	99.9914	0,008	0.0005	0.9735	0.9335
(10-5-5-5-5-2)	99.9860	0.0140	0.0124	0.9043	0.8800	99.9925	0,007	0.0033	0.9749	0.6273
(10-10-10-5-5-2)	99.9749	0.0251	0.0001	0.9629	0.9237	99.9934	0,006	0.0002	0.9241	0.9543
(10-10-10-10-5-	99.9765	0.0235	0.0004	0.9680	0.8373	99.9843	0,015	0.1123	0.9427	0.8724

Table 3. ANN Training And Testing

The best network model was obtained to carry out the classification process with the 10-10-5-5-2 model. This model consists of 1 input layer of 10 units, 3 hidden layers of 10-5-5 units, and 1 output layer of 2 units. This model provides quite good scores for Accuracy, Palm, Gradient, Sensitivity, and Validation.

The visualization form of the learning process image can be seen in Figure 3.

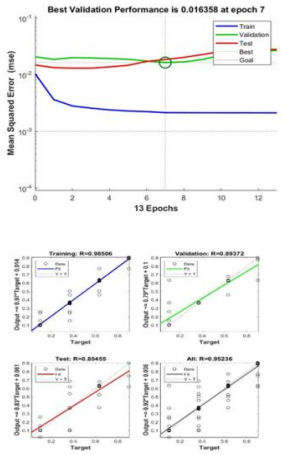

Figure 3. ANN Learning Graph

Figure 3 presents a visualization of learning results with interpretation based on Performance, Gradient, Error Histogram and Regression graphs. These results show that the DL concept with the ANN method can provide precise and accurate classification results.

CONCLUSION

Based on the results of this research, it was possible to develop an otitis diagnosis model that uses the Classification Deep Learning approach by optimizing the Rough Set method and applying Certainty Factor. The research results show that the combination of these various methods can significantly increase the accuracy and reliability of otitis diagnosis. The use of Deep Learning, especially Artificial Neural Network (ANN) and Decision Tree, allows us to utilize computing power to recognize complex patterns in medical data. The Rough Set method helps to overcome the uncertainty in data that often exists in medical diagnoses. Additionally, the Certainty Factor provides a valuable level of certainty in medical decision making. The developed model has a very good level of accuracy in diagnosing otitis. This indicates that the integration between Deep Learning, Rough Set, Certainty Factor, and Decision Tree has brought great benefits in the medical context. This research can be the basis for the development of a more sophisticated otitis diagnosis system that can be implemented in daily medical practice. The superiority of this model in diagnostic accuracy can speed up appropriate treatment and save the lives of patients with otitis. Thus, this research not only presents a scientific contribution, but also has a positive impact on improving the quality of public health care.

ISSN : 1979-9292
E-ISSN : 2460-5611

ACKNOWLEDGEMENTS

The author would like to thank Dr. Hj. Zerni Melmusi, SE, MM, Ak, CA, as chairman of the YPTK Padang Computer College Foundation which has provided a research funding grant for SIMLITUPI YPTK Padang 4.1 2023 as stated in the research contract agreement letter **No.215/UPI-YPTK/LPPM/P/ P/IX/2023**.

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