# ANFIS IMPLEMENTATION FOR EARLY DIAGNOSIS IN LUNGS DISEASE AT REGISTRATION UNIT RSP DR. M. GOENAWAN PARTOWIDIGDO CISARUA BOGOR

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## ABSTRACT

Early diagnosis is a process that is useful for doctors, especially specialist of lungs as information to provide further action, along with other investigations such as laboratory, radiology and mantoux. Based on interviews and observations, the problem is the lack of early diagnosis process to the patient and recording of the diagnosis during the registration process, whereas early diagnosis is required by a doctor as resource information for examination or further action. To solve the problem, will be making early diagnosing system in lung disease at enrollment unit RSP Dr. M. Goenawan Partowidigdo Cisarua Bogor using ANFIS method.

In conducting the analysis, there are two variables that determine the result of the early diagnosing lungs disease, namely variable of symptoms and variable of smoking. Variable of symptoms consisting of 13 types, weakness, coughing up blood, fever, cough with phlegm, chest pain, sore throat, hard to breathe, dry cough, nausea, lack of appetite, decongestants, headache, and abdominal pain. Meanwhile, the smoking variables ther are 3 categories, no smoking, rarely smoke, frequent smoking.

Based on the results of the test case 1 and case 2 using the confusion matrix, it could be concluded that the method of Adaptive Neuro Fuzzy Inference System can produce accurate results with 93,33%.

**Keywords** : early diagnosis, doctor, ANFIS, symptoms, lung disease, smoking

## 1. INTRODUCTION

Early diagnosis is a process that is useful for doctors, especially specialist of lungs as information to provide further action, along with other investigations such as laboratory, radiology and mantoux.

Based on interviews and observations, the problem is the lack of early diagnosis process to the patient and recording of the diagnosis during the registration process, whereas early diagnosis is required by a doctor as resource information for examination or further action.

With the advancement of science in artificial intelligence, a problem in the process of early diagnosis, can be made so that it can provide accurate results in accordance with the restrictions and requirements that have been determined. One of the methods for this problem is a method of Adaptive Neuro Fuzzy Inference System (ANFIS). ANFIS is a method that uses neural networks to implement fuzzy inference systems [1]. ANFIS method have all of advantages possessed by fuzzy inference systems and neural network systems.

To solve the problem, will be making early diagnosing system in lung disease at enrollment unit RSP Dr. M. Goenawan Partowidigdo Cisarua Bogor using ANFIS method.

## 2. LITERATURE REVIEW

### 2.1 Artificial Inteligence

Artificial intelligence is one part of the computer science that studies how to make a machine (computer) that can do the job as it is done by humans could even be better than that done by humans [2].

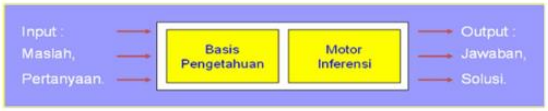
According to John McCarthy in 1956, artificial intelligence is to know and to model the processes of humans thinking and designing machines that can imitating human behavior. Intelligent, means having knowledge plus experience, reasoning, and good morals. Humans can resolve the problem because humans have knowledge and experience. Knowledge gained from the study so more and more knowledge, would be better able to solve the problems. Obviously with only have knowledge is not enough because humans are given mind to do reasoning and make decisions / conclusions based on knowledge and experience.

Including the engine, in order to be intelligent, it must be given the knowledge, so as to have the ability to make sense of the problem. To make the application of artificial intelligence, there are 2 main parts that are important, namely:

a. Knowledge bases, are the facts, theories, ideas and relations between one another.

b. Inference Engine is the ability to draw conclusions based on their knowledge and experience.

Implementation of the concept of artificial intelligence in computers are:




**Gambar 2.1 Concept of Artificial Intelligence**

## 2.2 Neuro Fuzzy Inference System

Neuro Fuzzy Inference System is a group of rules and an inference methods are combined within a structure are connected then conducted training and adaptation (Kasabov, 2002). One of the models is a form of adaptive networks that function like fuzzy inference system is Adaptive Neuro Fuzzy Inference System (ANFIS) (Jang, 1997), and Dynamic Evolving Neuro Fuzzy Inference System (DENFIS) (Song, 2003) (Kasabov, 2002) [3].

In most of neuro fuzzy systems, used backpropagation learning algorithm to generate fuzzy rules with the membership function using Gaussian models are given separately. This resulted, if the number of input variables is added, it also increased the parameters that must be generated. Mizumoto (1997) introduced a learning algorithm on the neuro-fuzzy without having to change the form of fuzzy rules. This method is very efficient, especially if it is used to identify the functions of non-linear [4].

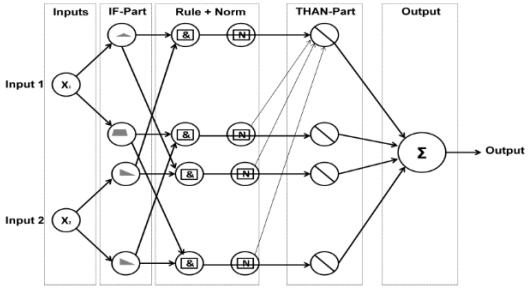
Sulzberger (1993), developed a method to optimize fuzzy rules by using neural network. At this research also developed a new neural network model that accommodates the translation of fuzzy rules and membership functions in the form of a network. Developed a method of neuro fuzzy through learning self-organization on the data that are trained to get optimum number of fuzzy rules and membership functions for generating center (Osowski, 2005) [4].

## 2.3 ANFIS (Adaptive Neuro Fuzzy Inference System) Method

ANFIS (Adaptive Neuro Fuzzy Inference System or Adaptive-based Fuzzy Inference System) is an architecture that is functionally similar to the fuzzy rule base Sugeno models. ANFIS architecture is similar to the function of the radial neural network with little limitations. It could be said that ANFIS is a method wherein in adjusting the rules used learning algorithms on a set of data. At ANFIS also allow the rules to adapt [1].

Adaptive Neuro Fuzzy Inference System (ANFIS) is an optimization technique that combines the concept of neural network with fuzzy logic. Neural networks recognize patterns and adjust to changing environmental patterns. Meanwhile, fuzzy logic combines human knowledge and draw conclusions to make a decision [5]. For systems based on linguistic rules, neural network technique will provide learning and adaptation capabilities for extracting parameters (premise and consequent) fuzzy rules from a set of numerical data. Specifically, neuro-fuzzy network eliminates the deficiencies in conventional fuzzy system design where the designer must make sense of the trial-and-error membership function of a fuzzy set defined on the input and output of the universe of discourse. ANFIS is a system of fuzzy inference implemented in adaptive networks. In ANFIS, the parameter is the premise membership functions and consequences. ANFIS learning is changing the parameters of the membership functions of the inputs and outputs [6].

## 2.2 ANFIS Architecture




**Gambar 2.2 ANFIS Architecture**

ANFIS network consists of layers as follows [4]:

1. Each neuron "i" on the first layer adaptive to parameters of an activation function. The output of each neuron in the form of degrees of membership given by the input membership functions, namely: $_{\alpha A1}(x1)$, $_{\alpha B1}(x2)$, $_{\alpha A2}(x1)$ atau $_{\alpha B2}(x2)$. For example, suppose the membership function is given as follows:

$$\mu(x) = \frac{1}{1 + \left|\frac{x-c}{a}\right|^{2b}} \quad \text{... 2.1}$$

where {a, b, c} are the parameters, typically b = 1. If the value of these parameters change, the shape of the curve that occurs will also change. The parameters on that layer is usually known as the premise parameters.

2. Each of neuron in the second layer in the form of neurons whose output is the result of input. Typically used the AND operator. Each of node represents α predicate of the rule to - i. All the nodes in this layer is non-adaptive (fixed parameter). This node is a function multiplying each incoming input signal. Node function are as follows:

$$O_{2.i} = w_i = \mu_{A_i}(x).\mu_{B_i}(y), untuk\ i = 1,2 \quad \text{... 2.2}$$

3. Each of neuron in the third layer in the form of a fixed node is the result of calculation of the ratio of α predicate (w), of the rules to - i against total number of α predicate.

$$\bar{w}_i = \frac{wi}{w1+\cdots+wn}, \textbf{ dengan i = 1,2.} \quad \textbf{... 2.3}$$

4. Each of neuron in the fourth layer is adaptive to an output node.

$$\bar{w}_i yi = \bar{w}_i(c_{i1}X_1 + C_{i2}x_2 + c_{i0}); \quad \textbf{... 2.4}$$

**dengan i = 1,2**

by $\bar{w}_i$ is normalized firing strength in the third layer and {ci1, ci2, ci0} are the parameters in these neurons. The parameters in the layer are called by the name of consequent parameters, with the following equation:

$$\Theta = \text{inv}(A^T A)A^T.y \quad \textbf{... 2.5}$$

With y is the value of output or output targets were predetermined. In searching for a consistent parameter, sought matrix A first obtained based on the normalization of the layer 3, by the following equation:

$$A = \begin{bmatrix} G1_I(\bar{W}_i) & \ldots & Sering_I(\bar{W}_i & \ldots & \bar{W}_i \\ \ldots & \ldots & \ldots & \ldots & \ldots \\ G1_{10}(\bar{W}_i) & \ldots & Sering_{10}(\bar{W}_i & \ldots & \bar{W}_i \end{bmatrix} \quad \textbf{... 2.6}$$

5. Each of neuron in the fifth layer is a fixed node that is the result of the sum of all inputs.

$$\sum_i \bar{w}_i yi = \frac{\sum_i w_i f_i}{w_i} \quad \textbf{... 2.7}$$

### 2.3 Lung Disease

Lungs are contained in human organs in the chest. Lungs has the function of inserting oxygen and remove carbon dioxide. After releasing oxygen, red blood cells will capture carbon dioxide as a result of metabolism of the body will be brought to the lungs. In the lungs, carbon dioxide and water vapor are released and expelled from the lungs through the nose. Lungs located inside the chest cavity (thoracic cavity), are protected by the collar bone structure and covered two walls, known as the pleura. These two layers are separated by a layer of air known as the pleural cavity containing pleural fluid.

In Table 2.1, there are disorders or diseases that may interfere with the function of the lungs and symptoms generally.

**Tabel 2.1 Lung Disease and Symptoms Generally**

| No. | Description | |
|---|---|---|
| | **Name of the Disease** | **Symptom** |
| **1.** | TB Paru | Body weakness, coughing up blood, fever, cough with phlegm, pain in the chest. |
| **2.** | Pharyngitis | Cough, sore throat, smoking habits, fever. |
| **3.** | Pneumonia | Fever, shortness of breath, chest pain, coughing up phlegm or dry cough, nausea. |
| **4.** | Effusi Pleura | Chest pain, shortness of breath, cough, fever. |
| **5.** | Lungs spots | Cough, fever, shortness of breath, chest pain, lack of appetite. |
| **6.** | Asthma | Coughing, incompressible nose, sore throat, shortness of breath. |
| **7.** | Bronchitis | cough phlegm, shortness of breath, fever, chest pain, a history of other diseases, headaches. |
| **8.** | Tumor Paru | Shortness of breath, cough, chest pain, lack of appetite, a history of other diseases, pain in the throat. |
| **9.** | PPOK | Sesak napas, nyeri pada dada, batuk, nafsu makan kurang, sakit kepala, nyeri pada perut, riwayat penyakit lain. |
| **10.** | Pneumothorax | Batuk kering, nyeri pada dada, sesak napas, riwayat penyakit lain. |

## 3. ANALYSIS

### 3.1 Analysis Method

Algorithm analysis performed in this study is to examine how the ANFIS algorithm in the system at the beginning of diagnosing lung disease. ANFIS algorithm has two variables: symptoms variable, and smoking habits variable. Here is a sample of the data that will be studied in the system to be built.

**First Layer**

In the first layer occurs fuzzification process. This process is to map input data into fuzzy set. In this process will be calculated fuzzy membership functions to transform inputs classic set to a certain degree. Membership function used is the type of Generalized-Bell. Calculations on this layer using equation (2.1).

**1. Symptom**

Variable symptom is a symptom experienced by each patient. Consisting of weakness, coughing up blood, fever, cough with phlegm, chest pain, sore throat, shortness of breath, dry cough, nausea, lack of appetite, incompressible nose, headache and abdominal pain. Its membership function is as follows:

**Tabel 3.1 The output of the First Layer Body Weakness (Symptoms)**

| No | G1 | | | DK |
|---|---|---|---|---|
| | **<2weeks** | **2weeks – 1month** | **>1month** | |
| **1** | 0.75384615 | 0.85663717 | 0.83160083 | 0.85663717 |
| **2** | 0.70758123 | 0.82876712 | 0.81591025 | 0.82876712 |
| **3** | 0.70758123 | 0.82876712 | 0.81591025 | 0.82876712 |

| | | | | |
|---|---|---|---|---|
| **4** | 0.70758123 | 0.82876712 | 0.81591025 | 0.82876712 |
| **5** | 0.70758123 | 0.82876712 | 0.81591025 | 0.82876712 |
| **6** | 0.70758123 | 0.82876712 | 0.81591025 | 0.82876712 |
| **7** | 0.70758123 | 0.82876712 | 0.81591025 | 0.82876712 |
| **8** | 0.70758123 | 0.82876712 | 0.81591025 | 0.82876712 |
| **9** | 0.70758123 | 0.82876712 | 0.81591025 | 0.82876712 |
| **10** | 0.70758123 | 0.82876712 | 0.81591025 | 0.82876712 |

**Tabel 3.2 The output of the First Layer (Smoking Habit)**

| No | Not | Rarely | Often |
|---|---|---|---|
| | | | |
| **1** | 0.9245283 | 0.06758621 | 0.00723461 |
| **2** | 0.98 | 0.06758621 | 0.00723461 |
| **3** | 0.98 | 0.06758621 | 0.00723461 |
| **4** | 0.98 | 0.06758621 | 0.00723461 |
| **5** | 0.9245283 | 0.06298201 | 0.00706255 |
| **6** | 0.9245283 | 0.06758621 | 0.00723461 |
| **7** | 0.98 | 0.06758621 | 0.00723461 |
| **8** | 0.98 | 0.06758621 | 0.00723461 |
| **9** | 0.98 | 0.06758621 | 0.00723461 |
| **10** | 0.98 | 0.06758621 | 0.00723461 |

In Table 3.2, there results Fuzzy membership functions of smoking (no), smoking (rare) and smoking (often), whereas in Table 3.1 are the result of the function of the fuzzy membership of symptoms (weakness), symptoms (coughing up blood), symptoms (fever), symptoms (cough with phlegm), symptoms (chest pain), symptoms (sore throat), symptoms (shortness of breath), symptoms (dry cough), symptoms (nausea), symptoms (lack of appetite), symptoms (nasal incompressible), symptoms (headaches), symptoms (abdominal pain). Results of this fuzzy membership function, will be used to find the value Wi.

**Second Layer**

The output of layer 2 is the result of the multiplication of all the incoming data. Each output node degree activation states of fuzzy rules. The second layer output calculation using equation (2.2).

At this layer, Wi value will be calculated for each degree of membership of the symptoms.

**Tabel 3.3 The output of the Second Layer**

| No | $W_1$ | $W_2$ | $W_3$ |
|---|---|---|---|
| 1 | 6.9154E-06 | 1.06227E-05 | 3.53108E-05 |
| 2 | 6.88045E-06 | 1.094E-05 | 3.67232E-05 |
| 3 | 7.80961E-06 | 1.1887E-05 | 3.81492E-05 |
| 4 | 7.33032E-06 | 1.15003E-05 | 3.74294E-05 |
| 5 | 6.70238E-06 | 1.0245E-05 | 3.27405E-05 |
| 6 | 6.9154E-06 | 1.06878E-05 | 3.53108E-05 |
| 7 | 6.88045E-06 | 1.10093E-05 | 3.67232E-05 |
| 8 | 7.80961E-06 | 1.18845E-05 | 3.81492E-05 |
| 9 | 8.32024E-06 | 1.22322E-05 | 3.88828E-05 |
| 10 | 6.45818E-06 | 1.05521E-05 | 3.60303E-05 |

**Third Layer**

Each of neuron in the third layer in the form of a fixed node is the result of the calculation of the ratio of α predicate (w), of the rules to - i against total number of α predicate. Calculation of layer 3, using equation (2.3). This result is known as the normalized firing strength.

$$\overline{W_1} = \frac{W_1}{W_1+\cdots W_3} = \frac{6.9154\text{E}{-}06}{5.28489\text{E}{-}05} = 0.949421811$$

$$\overline{W_2} = \frac{W_2}{W_1+\cdots W_3} = \frac{0.00000000029}{5.28489\text{E}{-}05} = 0.003763633$$

$$\overline{W_3} = \frac{W_3}{W_1+\cdots W_3} = \frac{0.00000000031}{5.28489\text{E}{-}05} = 0.004067667$$

Normalization was performed on all input data that is 10 data, the results can be seen in the following table:

**Tabel 3.4 The output of the Third Layer**

| No | $\overline{W_1}$ | $\overline{W_2}$ | $\overline{W_3}$ |
|---|---|---|---|
| 1 | 0.1308523 | 0.201002 | 0.6681456 |
| 2 | 0.1261458 | 0.2005735 | 0.6732808 |
| 3 | 0.1350074 | 0.205495 | 0.6594977 |
| 4 | 0.1302937 | 0.2044133 | 0.6652931 |
| 5 | 0.1348897 | 0.2061875 | 0.6589228 |
| 6 | 0.1306915 | 0.2019839 | 0.6673246 |
| 7 | 0.1259856 | 0.2015883 | 0.6724261 |
| 8 | 0.1350133 | 0.2054599 | 0.6595267 |
| 9 | 0.1399883 | 0.2058071 | 0.6542046 |
| 10 | 0.1217592 | 0.1989442 | 0.6792965 |

**Fourth Layer**

The degree value activation of the firing strength of the layer 3 will be used as an input value to determine the consequent parameters Θ (theta) using Least Square Estimate (LSE), the following steps consequent determination of the parameters:

a. Results of the normalization of the layer 3 to be formed in a matrix A. A number of rows in a matrix of 10 by using equation (2.6).
b. From the matrix, will look for the value of the parameter consequent ai, bi, ci, di, ei, fi, gi, hi, ii, ji, ki, li, mi, ni, oi, pi, ri using the LSE by using equation (2.5).

**Tabel 3.5 Consequent parameters**

| Θ | | | | | |
|---|---|---|---|---|---|
| -0.836380309 | **a1** | -0.068228152 | **a2** | -0.95254025 | **a3** |
| -0.836380309 | **b1** | 0.549783241 | **b2** | 2.923686764 | **b3** |
| -0.560285622 | **c1** | 0.757419308 | **c2** | 0.83848892 | **c3** |
| -2.130629515 | **d1** | -1.666279726 | **f2** | 2.431617029 | **d3** |
| -0.500052158 | **e1** | -0.65553669 | **e2** | 2.431617029 | **e3** |
| 0.057304255 | **f1** | 0.557013011 | **f2** | 3.201380672 | **f3** |
| 0.040277036 | **g1** | -0.076396596 | **g2** | -0.255536283 | **g3** |
| -1.466287132 | **h1** | 0.396635783 | **h2** | -0.710187922 | **h3** |

| | | | | | |
|---|---|---|---|---|---|
| -0.68365217 | **i1** | 0.396635783 | **i2** | -0.710187922 | **i3** |
| 0.102724026 | **j1** | 0.638795334 | **j2** | 0.166705953 | **j3** |
| -0.296051116 | **k1** | -1.920488106 | **k2** | -0.022024723 | **k3** |
| 0.001991228 | **l1** | -1.920488106 | **l2** | -0.317619033 | **l3** |
| 0.001991228 | **m1** | 0.394307341 | **m2** | -0.317619033 | **m3** |
| 0.166705953 | **n1** | -7.344173252 | **n2** | 0.638795334 | **n3** |
| -0.902044055 | **o1** | 1.847282215 | **o2** | 0.814513832 | **o3** |
| -0.902044055 | **p1** | 3.151036675 | **p2** | 1.304868069 | **p3** |
| -0.356253683 | **q1** | 4.606259242 | **q2** | 1.304868069 | **q3** |
| -2.748443879 | **r1** | -3.434761465 | **r2** | 3.201380672 | **r3** |

Furthermore, the value of $a_i \ldots a_n$, $b_i \ldots b_n$, $c_i \ldots c_n$, $d_i \ldots d_n$, $e_i \ldots e_n$, $f_i \ldots f_n$, $g_i \ldots g_n$, $h_i \ldots h_n$, $i_i \ldots i_n$, $j_i \ldots j_n$, $k_i \ldots k_n$, $l_i \ldots l_n$, $m_i \ldots m_n$, $n_i \ldots n_n$, $o_i \ldots o_n$, $p_i \ldots p_n$, $q_i \ldots q_n$, $r_i \ldots r_n$ will be used for the calculation of the fourth layer. The process of calculating at this layer, using equation (2.4). Results of these calculations are as follows:

**Tabel 3.6 Output from the Fourth layer**

| Data Ke- | $\overline{W_1}f_1$ | $\overline{W_2}f_2$ | $\overline{W_3}f_3$ |
|---|---|---|---|
| 1 | -2.469390318 | -3.793226 | -12.60896 |
| 2 | 0.505958041 | 0.8044802 | 2.7004619 |
| 3 | 3.052213565 | 4.6457799 | 14.909761 |
| 4 | -2.309166882 | -3.622772 | -11.79085 |
| 5 | -0.343869517 | -0.525627 | -1.679769 |
| 6 | 3.142047448 | 4.8560376 | 16.043621 |
| 7 | -2.048085063 | -3.27712 | -10.93129 |
| 8 | 0.42668841 | 0.6493239 | 2.0843306 |
| 9 | 3.081271358 | 4.5300039 | 14.399646 |
| 10 | -1.830269204 | -2.990504 | -10.2111 |

**Fifth layer**

After getting the results of the fourth layer, the next step is defuzzification, by summation. The process of calculating at this layer, using equation (2.7). Here are the results from the defuzzification of 10 entered data:

**Tabel 3.7 The output of the Fifth Layer**

| $\sum \overline{w}_i f_i$ |
|---|
| -18.87157998 |
| 4.010900135 |
| 22.60775417 |
| -17.72278541 |
| -2.549264529 |
| 24.04170592 |
| -16.25649827 |
| 3.160342876 |
| 22.01092105 |
| -15.03187027 |

Results of the fifth layer is output in the analysis using ANFIS method in one iteration.

**RMSE (Root Mean Squared Error)**

RMSE is an alternative method to evaluate forecasting techniques. RMSE is the average squared differences between the estimated values with observed values of a variable. If the value of the estimated RMSE smaller models or variables are more valid. RMSE calculation following the first phase of the 10 entered data.

$$RMSE = \sqrt{\frac{\sum_{i=1}^{n}\left(Y_i - (\sum \overline{w_i} f_i)\right)^2}{n}} \quad \text{... 3.1}$$

$$= \sqrt{\frac{(1-(-18.87157998))^2 + \cdots + (10-(-15.03187027))^2}{10}} = 17.31452$$

with:
Y = the value of the actual output
$\overline{w_i} f_i$ = the output value of forecasting
N = the amount of data (10)

# 4. IMPLEMENTATION & TESTING

## 4.1 Hardware Implementation8

**Tabel 4.1 Hardware Implementation**

| | |
|---|---|
| Processor | Intel Pentium IV 2.7 GHz |
| VGA | On-Board |
| Memory | 1GB DDR3 |
| Input | *Keyboard* & *Mouse* |
| Monitor | *Monitor* 17" with a resolution 1366 x 768 |

## 4.2 Software Implementation

The software used in this system are as follows:

**Tabel 4.2 Software Implementation**

| | |
|---|---|
| Operating system | Windows 7 |
| Programming language | C# |
| Web Server | XAMPP versi 3.2.1 |

## 4.3 implementation of interface

Here is an implementation of the interface in the implementation of ANFIS for the early diagnosis of

Pulmonary Disease At Registration Unit RSP Dr. M. Goenawan Partowidigdo Cisarua, Bogor.

**Login page interface**

Used for access into the implementation of ANFIS for early diagnosis in lung disease.




**Gambar 4.1 Login page interface**

**Interface of Main Page**

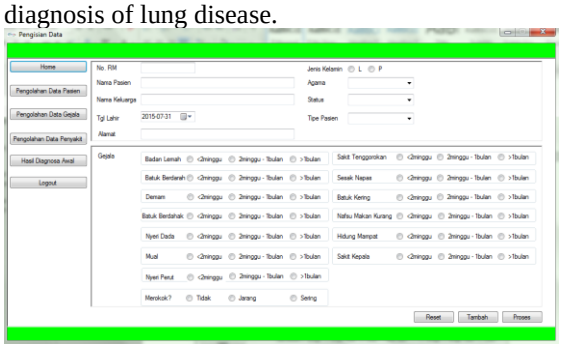
Used as the main display interface from implementation ANFIS for early diagnosis in lung disease.




**Gambar 4.2 Interface of Main Page**

**Interface of Enter Data**

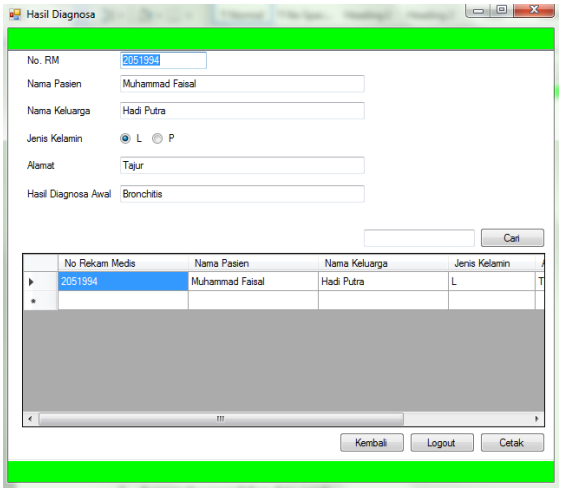
Used to enter data which will produce output early diagnosis of lung disease.



**Gambar 4.3 Interface of Enter Data**

**Interface of Early Diagnosis Results page**

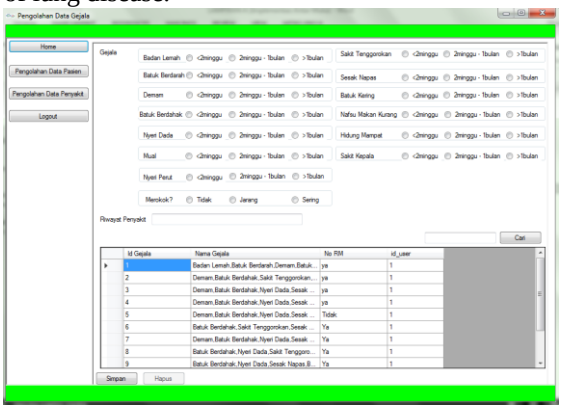
Used to view and print the results of early diagnosis in lung disease experienced by the patient.




**Gambar 4.4 Interface of Early Diagnosis Results page**

**Symptoms Data Processing Interface**

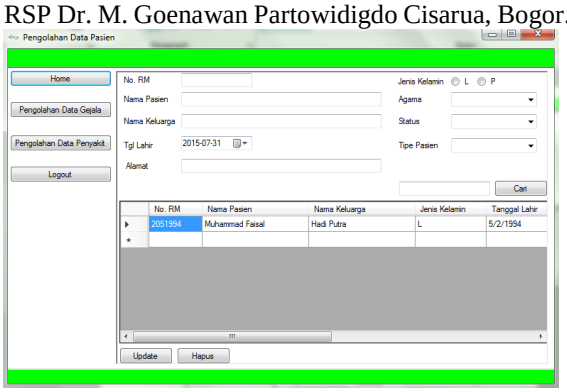
Used to perform data processing on the symptoms of lung disease.



**Gambar 4.5 Symptoms Data Processing Interface**

**Patient Data Processing Interface**

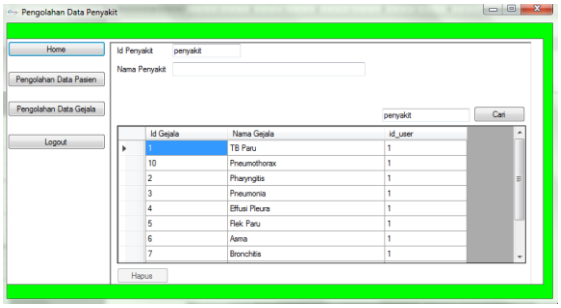
Used to perform data processing in patients in RSP Dr. M. Goenawan Partowidigdo Cisarua, Bogor.




**Gambar 4.6 Patient Data Processing Interface**

**Disease Data Processing Interface**

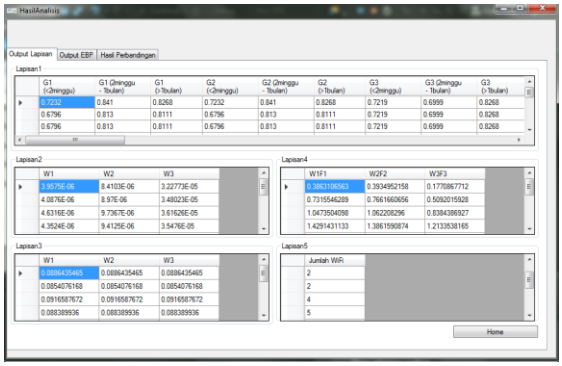
Used to perform data processing of lung disease.



**Gambar 4.7 Disease Data Processing Interface**

**Analysis (Output Layer) Interface**

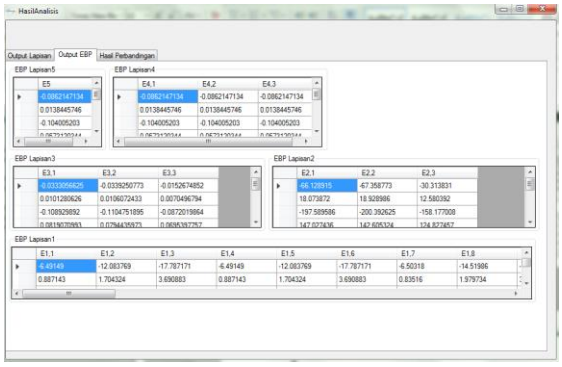
Used to view the output layer of analysis ANFIS method.



**Gambar 4.8 Analysis (Output Layer) Interface**

**Analysis (Output EBP) Interface**

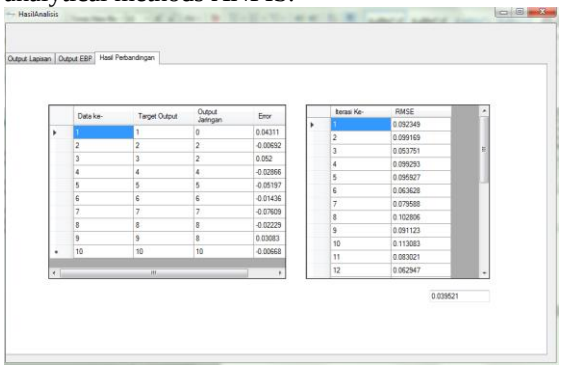
Used to see the results of the analysis output EBP ANFIS method.



**Gambar 4.9 Analysis (Output EBP) Interface**

**Analysis Results (Comparative Results) Interface**

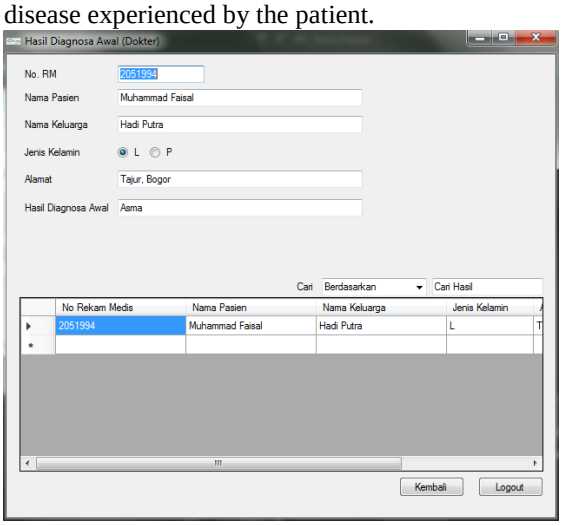
Used to see the results of the comparison of analytical methods ANFIS.



**Gambar 4.10 Analysis Results (Comparative Results) Interface**

**Early Diagnosis Results Interface (Doctor)**

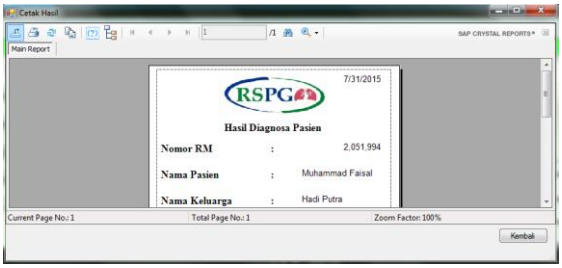
Used to see the results of early diagnosis in lung disease experienced by the patient.




**Gambar 4.11 Early Diagnosis Results Interface (Doctor)**

**Page Print Results Interface**

Used to print the results of early diagnosis in lung disease.




**Gambar 4.12 Page Print Results Interface**

## 4.4 Testing Systems

Testing of the system is the cornerstone that aims to find errors or deficiencies in the software being tested. Testing intended to determine the software that has been built or made already meet the criteria in accordance with the purpose of designing the software.

**Plans and Scenario Testing**

In this test, use black box method that focuses on the functional requirements of the software. Scenario testing to be performed are as follows:

**Tabel 4.3 Testing Skenario**

| No. | Class Test | Points Tests | Types of Tests |
|---|---|---|---|
| 1. | Login | Verify the login data using the username and password | *Black Box* |
| 2. | Enter Data | Add data symptoms suffered by patients | *Black Box* |
| 3. | Data processing | Add patient data | *Black Box* |
| | | Changing patient data | |

| | | | |
|---|---|---|---|
| | | Deleting patient data | |
| | | Search for patient data | |
| | | Adding Data disease | |
| | | Looking for disease data | |
| 4. | ANFIS Analysis Results | Load the input data | *Black Box* |
| | | Calculating the layer 1 through layer 5 | |
| | | Calculating EBP layer 5 to EBP layer 1 | |
| | | Calculating error in the calculation | |
| 5. | Early Diagnosis Results | Search for patient data that has been made early diagnosis | *Black Box* |
| | | Print the results of the early diagnosis | |

### 4.5 Testing of Cases

Testing of the case is a test that is performed directly on the data analysis of existing in the ANFIS Implementation for Early Diagnosis at Registration Unit RSP Dr. M. Goenawan Partowidigdo Cisarua Bogor. This test is intended to determine the output of early diagnosis in lung disease. These tests show the calculation results on the learning process of the data analysis or data symptoms related to the early diagnosis on 10 lung disease were tested and the accuracy of the calculation on the learning process, which will show whether the method of ANFIS can do diagnosing early on lung disease is well using the Confusion Matrix.

**Test Case Scenario 1**

In the first test, will be carried out by using 15 test data by using parameters that max epoch = 100 and error tolerance values are 0.005, 0.004, 0.003, 0.002, 0.001. Here is a description of test case scenario 1:

**Tabel 4.4 Test Case Scenario 1**

| Scenario | Error Tolerance | Max epoch |
|---|---|---|
| 1 | 0,005 | 100 |
| 2 | 0,004 | 100 |
| 3 | 0,003 | 100 |
| 4 | 0,002 | 100 |
| 5 | 0,001 | 100 |

**Results of Test Case Scenario 1**

From the data of the test case scenario 1, the overall results obtained are shown in Table 4.5.

**Tabel 4.5 Results of Test Case Scenario 1**

| Skenario | *Max epoh* | Toleransi *error* | Akurasi |
|---|---|---|---|
| 1 | 100 | 0,005 | 80% |
| 2 | 100 | 0,004 | 80% |
| 3 | 100 | 0,003 | 86.67% |
| 4 | 100 | 0,002 | 80% |
| 5 | 100 | 0,001 | 73.33% |

**Test Case Scenario 2**

In the second test, to be carried out by using 15 test data by using parameters that max epoch = 100, 200, 300, 400, 500 and error tolerance value is 0.003. Here is a description of test scenario Case 2:

**Tabel 4.6 Test Case Scenario 2**

| Skenario | Toleransi *error* | *Max epoh* |
|---|---|---|
| 1 | 0,003 | 100 |
| 2 | 0,003 | 200 |
| 3 | 0,003 | 300 |
| 4 | 0,003 | 400 |
| 5 | 0,003 | 500 |

**Results of Test Case Scenario 2**

From the data of the test case scenario 2, the overall results obtained are shown in Table 4.7.

**Tabel 4.7 Results of Test Case Scenario 2**

| Scenario | Max Epoch | Error Tolerance | accuracy |
|---|---|---|---|
| 1 | 100 | 0,003 | 86.67% |
| 2 | 200 | 0,003 | 80% |
| 3 | 300 | 0,003 | 93.33% |
| 4 | 400 | 0,003 | 93.33% |
| 5 | 500 | 0,003 | 93.33% |

**Conclusion Test Case**

Based on the results of the test case 1 and test cases 2, it can be deduced that the max epoch and the determination of the value of error tolerance enough to affect the amount of accuracy, can be seen from the results of the test case 1 that tolerance error = 0.003 and max epoch = 100 can produce an accuracy of 86, 67% whereas in the second case testing the error tolerance value = 0.003 and max epoch = 300, 400 and 500 can produce an accuracy of 93.33%.

Based on the results of the test case 1 and case 2 using the confusion matrix, it could be concluded that the method of Adaptive Neuro Fuzzy Inference System can produce initial diagnosis with the greatest accuracy is 93.33%.

## 5. FINALE

This part is a cover containing the research conclusions and suggestions for future research.

### 5.1 Conclusion

Based on the results of research, analysis, system design and programming up to the stage of completion of the application, the writer can draw conclusions based on the results of the test case 1 and case 2 using the confusion matrix, it could be concluded that the method of Adaptive Neuro Fuzzy Inference System can produce a diagnosis beginning with the greatest accuracy is 93.33% with an average accuracy obtained from testing the test case 1 and case 2 is 84.66%.

### 5.2 Suggestions

To improve future research on the implementation of ANFIS for early diagnosis of lungs disease at registration Unit RSP Dr. M. Goenawan Partowidigdo Cisarua Bogor, the authors propose some suggestions that can be considered are:

1. Model of early diagnosing on lung disease using the ANFIS method can still be developed further

by adding other symptoms that have the possibility to generate result of early diagnosis on lung disease more specific.

2. Hardware specifications to perform the analysis on this system can be said to be lacking, because when analyzing the computer was hang.

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