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DETERMINATION OF A TASK FORCE FOR NEW POLICE OFFICERS AT THE STATE POLICE SCHOOL USING A FULLY RECURRENT NEURAL NETWORK

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Abstract

Artificial Neural Networks (ANN) can be used to solve specific problems such as prediction, classification, processing data, and robotics. Based on the exposure, this study tried to develop a system by applying ANN models Fully Recurrent Neural Network (FRNN) to deal with the problems of classification determination unit for New Police Officer at NES Kupang include DitSabara, DitPolAir, and SatBrimob, which has been using the system manually, the ANN system Fully Recurrent Neural Networks can provide accurate information to the NES Kupang to determine the right decision. Fully Recurrent Neural Network structures have been presence of feedback that can make faster iteration thus making the update parameters and convergence speed become faster. The learning method used is Backpropagation Through Time . The system is implemented using the C# program. Input vectors used consisted of 7 variables.The results showed t the developed system will rapidly converge and able to achieve the most optimal error value (minimum error) when using one hidden layer with 17 units of the number of neurons . The best accuracy can be obtained using the LR of 0.001 , target of 0.1 and momentum 0.95, with 25 test data of data, the system accuracy reaches 96%, while the real data, the accuracy reached 83.33%..

Keywords: Determination; work unit; Fully Recurrent Neural Network;

INTRODUCTION

Human Resource Management (HR) is an important part of companies, government agencies and educational and training institutions that greatly affect many aspects of HR success in determining the success of work of every company, government and private agencies as well as educational and training institutions (Mahapatro, 2022). The process of determining the work unit is a very decisive process in getting competent employees / personnel needed in an institution or agency, because the right placement in the right position will be able to help the institution in achieving the expected goals (Kurniawati, 2021).

In the process of education and training, the New Police Officer students are given tests related to the material and training obtained at the Kupang National Police, so that from these tests obtained values that will later be used as evaluation material for the determination of graduation for the New Police Officers. The values that will later be used in the graduation process of DIKTUKBRIG Polri students are 3 aspects which include Academic, Mental, and Samjas. These three aspects will be reported at the SPN leadership council session to be used as a reference in determining the graduation of DIKTUKBRIG Polri students. According (Rassi, 2022). (Martens et al., 2011) After being declared graduated, DIKTUKBRIG Polri students will be inaugurated and then the process of determining the work unit for New Police Officers in the NTT POLDA regional work unit is carried out, the system applied is a manual system (lottery withdrawal) for the determination of work units (Dit.Sabara, Dit.PolAir, and SatBrimob), for each Police Brigadier who gets the results of the manual system is the final result to be used in directing and placing them in the work unit that exist (No, 20 C.E.).

This certainly affects the performance and work performance of police personnel when carrying out duties and responsibilities in existing work units (Tongo-Tongo, 2014). The current system also results in errors in placing personnel in jobs that are not in accordance with competencies based on standard criteria for determining the Indonesian police (Meutia & Liu, 2019).

Based on the description of the problem, it is necessary to build a system that can assist the Kupang SPN in overcoming the problem of determining a work unit for new police officers. JST is applied to deal with this problem, because it has the ability to store knowledge gained from experiences resembling the work of the human brain (Norvig & Intelligence, 2002). The JST structure used is a Fully Recurrent Neural Network which has feedback connections from the hidden layer and output layer to optimize network work (Samarasinghe, 2016). So it is hoped that the existence of a work unit determination system for new police officers using the FRNN model can help determine work units with better accuracy of results and can be used as a reference to help facilitate decisions related to the problems faced.

METHOD RESEARCH

System analysis is carried out to determine the needs of the software used, so that there is a relationship between system makers and system users. System analysis includes: data requirements, expected capabilities and facilities, input vectors, and targets of the system to be developed (Rachmawati, 2017).

The system to be built, will be used to assist in the process of determining work units for new police officers using neural networks with the FRNN model at the Kupang SPN and is then expected to produce an output that can be used as a reference in determining an appropriate decision related to existing problems.

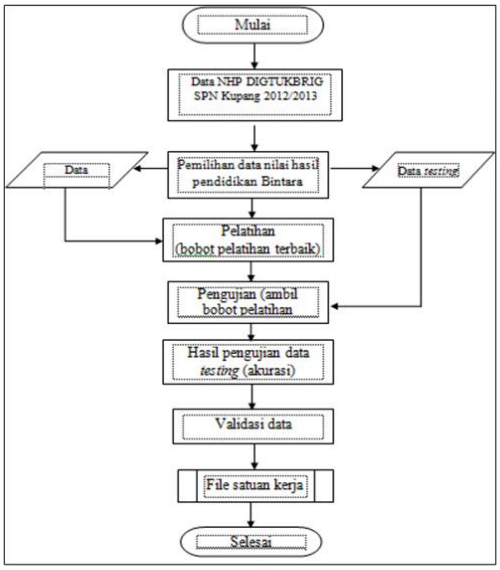


Figure 1. Flow chart of the unit determination system

In the process of determining this work unit, it is presented in a system flow chart that has a data collection process for determining work units, in the form of three aspects including Academic Values: Introduction to educational orientation (POP), KU (general competence), KUT (main competence), KKS (special competence), Latnis Value (training and technical), Mental Value, and Samjas Value, from SPN Kupang which is then selected into training data and testing data (LESTARI, 2021). The training data will be processed in the system so that these two processes are each given different data, namely training data as much as 75 data and testing data as much as 25 data. During the training process with a total of 75 data by JST FRNN, the best final weight was stored in the weight file, for further use during the testing process, in the testing process the data was loaded from 25 exel data. The testing process is carried out by taking the best weight of the results of previous training. The results of the testing process are in the form of system accuracy in the introduction of testing data, to see the results of the determination of work units, a data validation process is carried out which shows the results of the classification of work units which contain the number of New Police Non-commissioned Officers divided into each work unit, namely Dit.Sabara, Dit.PolAir, and SatBrimob. These results will then be stored in the work unit determination file. Flow diagram of the work unit system as described in

FRNN architectural design of the system under development. FRNN consists of several layers, including input layers, hidden layers, and output layers. The input layer consists of 7 neurons, with a number of neuron units in the hidden layer, and the output layer consists of 2 neurons (Kosasi, 2014). The input vector is propagated through weighted layers that are done randomly. The initialization of weights and thresholds in the network is distributed randomly in a range like equation 1, where Fi is the number of input neurons.

The hidden layer and the number of neurons are determined by trial and error, with the aim of achieving the most optimal error value (minimum error), with the number of neurons in the hidden layer will be the same as the neurons in the context unit. As for the number of neurons in the output layer will be the same as the neurons in the context unit.

The number of neurons in the context layer has the same number of neurons in the hidden and output layers. This also causes the context layer to be referred to as the copy context, because it duplicates the output of the hidden layer and the output layer. Neurons in the output layer have two neurons, Z1 and Z2, and have two context units. Overview of FRNN architectural design, as shown in Figure 2.

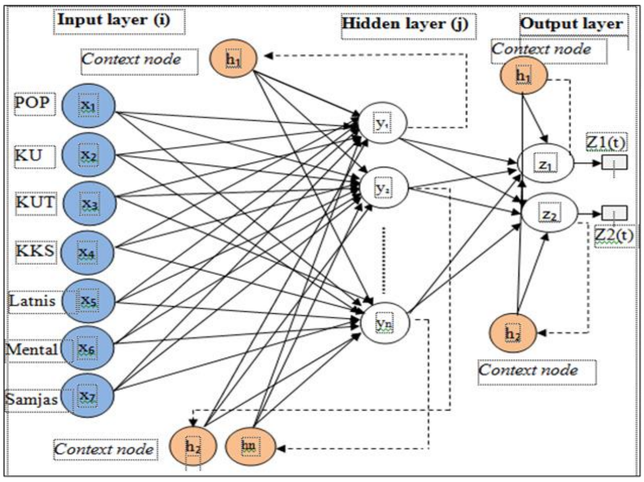


Figure 2. FRNN system architecture design

In the system flow chart, there are two main processes, namely the training process and the testing process, each of which is given a different amount of data, namely training data as much as 75 data and testing data as much as 25 data. Before learning the training data, first set the parameter values as follows epoch, error target, learning rate, number of outputs, number of hidden layers, momentum, which is then carried out initialization of network weights, after initializing the weights, the next process is to take training data. This process is carried out feedforward by the network from the input signal propagated (calculated forward) to the hidden layer to the output layer using the binary sigmoid activation function, thus producing the JST output (Baig et al., 2017). The next process is to calculate errors in the output layer neurons and hidden layer neurons, with a backward count, the error obtained is the difference between the network output and the target data that occurs in the output neuron, resulting in a final weight. The process of updating weights is done by modifying weights to reduce errors that occur. This takes place in changing the weight of the hidden layer, changing the weight of the input and changing the weight of the context unit. This weight change lasts until long as the output is not equal to the target. The flowchart for the training process is shown in Figure 3

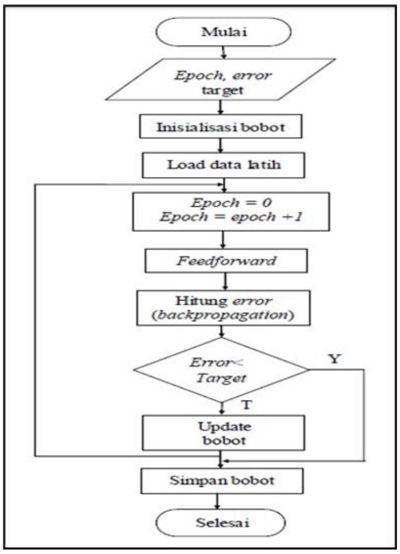


Figure 3. Flowchart for training

In the testing process the optimal weight of training results is taken for use in the testing process, the testing data is processed feedforward by the network, resulting in JST output and normalized in the interval [0,1] so that it is equal to the JST interval range so that the final result is in the form of the results of determining the work unit stored in a file and can be accessed by the user. The flowchart for the testing process can be seen in Figure 4

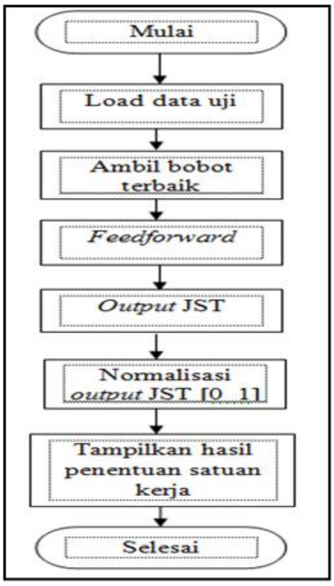


Figure 4. Flowchart for testing

The design of the work unit determination interface with the JST model Fully Reccurent Neural Network consists of one main menu (main window) for the JST process (training, and testing). The interface design developed on the software uses a user friendly system. The design of the main menu can be seen in Figure 5

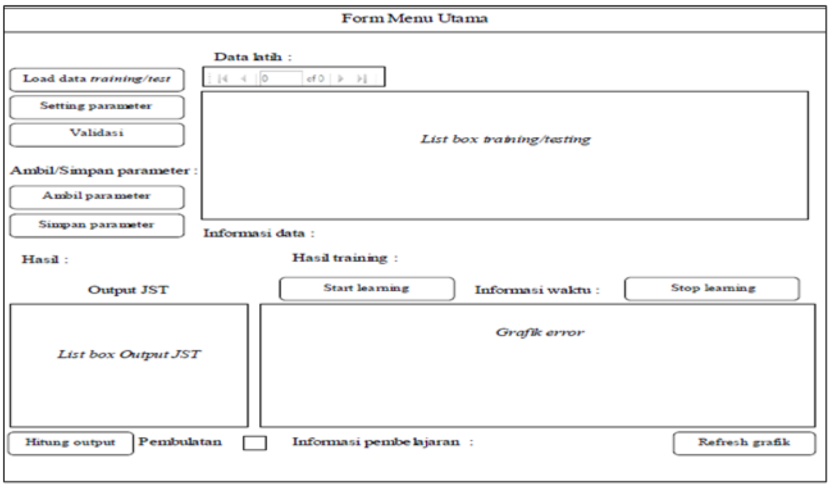


Figure 5. Main menu design

This software includes buttons List box training and testing serves to display training data and test data to be processed in JST, Training and testing data load button to retrieve JST training and test data, Parameter setting button to input parameters to be used in the JST training process, Parameter capture button serves to take weight of training results, Save parameter button serves to save the weight of JST training results, Star learning button serves to start the JST training process, Stop learning button serves to stop the training process on JST, Calculate output button serves to display output results from JST, Graph refresh button, serves to set the graph to normal form, Validation button, serves to display the results of determining work units, Data information serves to display the amount of training and testing data that will be processed JST, Time information, serves to display JST training time, Learning information serves to display epoch, SSE, and accuracy results, Output rounding, to display rounding of JST output results.

System Implementation

The implementation of this system is based on a pre-designed system architecture. In accordance with the system design, several pages that have been implemented will be displayed such as the main menu page, training and testing, the results of determining the satker. The implementation of the system interface design can be seen in Figure 6.

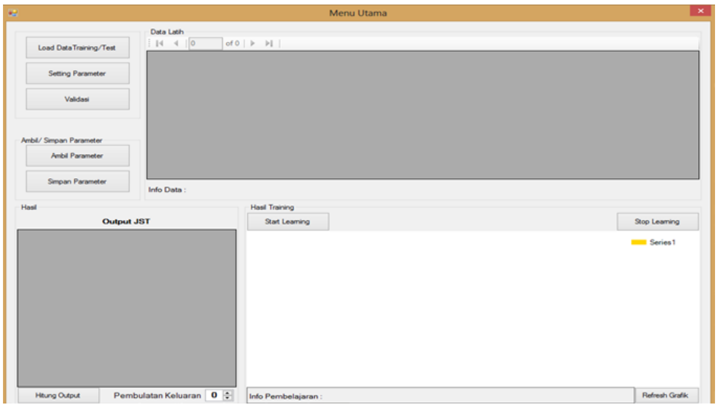


Figure 6. Implementation of interface design

Select the load training data menu to enter the training data into the data set. Before pressing the star learning button to start the process, several parameter values must be set for the initial process as follows, Input layer = 7, Output layer = 2, Learning rate (LR), = 0.0001, Number of hidden laye r = 1, Number of hidden layer neurons = 17, Momentum constant = 0.95, Target error = 0.1. The load data menu can be seen in Figure 7

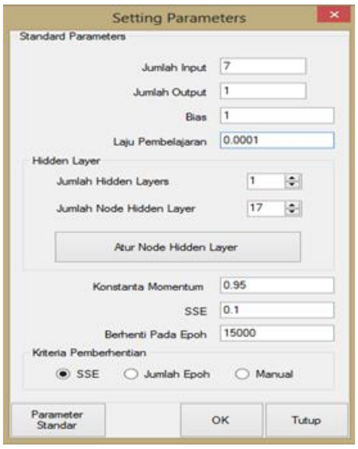
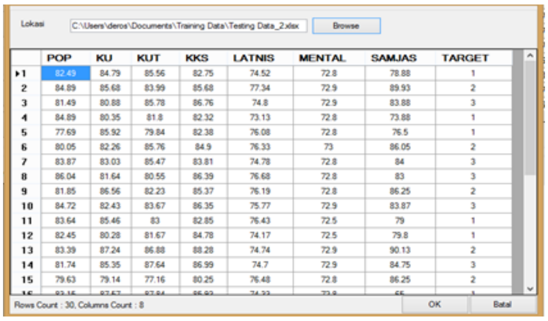


Figure 7. Implementation of the training interface

The best weighted results in the training process are used to calculate the output of new data through the testing process. Through the testing process, the system can provide information on how much the system processes in recognizing the correct data even though it has never been trained before. such as Figure 7 and Figure 8.

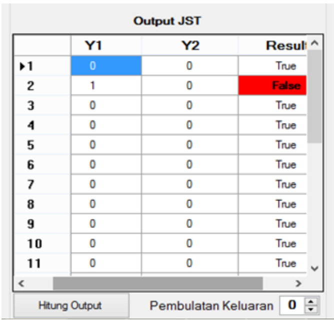


Lokasi C:\Users\deros\Documents\Training Data\Testing Data_2.xlsx Browse

	POP	KU	KUT	KKS	LATNIS	MENTAL	SAMJAS	TARGET
1	82.49	84.79	85.56	82.75	74.52	72.8	78.88	1
2	84.89	85.68	83.99	85.68	77.34	72.9	89.93	2
3	81.49	80.88	85.78	86.76	74.8	72.9	83.88	3
4	84.89	80.35	81.8	82.32	73.13	72.8	73.88	1
5	77.69	85.92	79.84	82.38	76.08	72.8	76.5	1
6	80.05	82.26	85.76	84.9	76.33	73	86.05	2
7	83.87	83.03	85.47	83.81	74.78	72.8	84	3
8	86.04	81.64	80.55	86.39	76.68	72.8	83	3
9	81.85	86.56	82.23	85.37	76.19	72.8	86.25	2
10	84.72	82.43	83.67	86.35	75.77	72.9	83.87	3
11	83.64	85.46	83	82.85	76.43	72.5	79	1
12	82.45	80.28	81.67	84.78	74.17	72.5	79.8	1
13	83.39	87.24	86.88	88.28	74.74	72.9	90.13	2
14	81.74	85.35	87.64	86.99	74.7	72.9	84.75	3
15	79.63	79.14	77.16	80.25	76.48	72.8	86.25	2

Rows Count : 30, Columns Count : 8 OK Batal

Figure 8. Implementation of testing against new data



Output JST

	Y1	Y2	Result
1	0	0	True
2	1	0	False
3	0	0	True
4	0	0	True
5	0	0	True
6	0	0	True
7	0	0	True
8	0	0	True
9	0	0	True
10	0	0	True
11	0	0	True

Hitung Output Pembulatan Keluaran 0

Figure 8. Implementation of testing against new data

The results of the determination of the task force are the final process to determine the recommended work unit for new police officers. The results of the satker determination are divided into three satker majors, including: Dit. Sabara, SatBrimob, and Dit. Polair. Information on the results of the determination can be seen as in Figure 10.

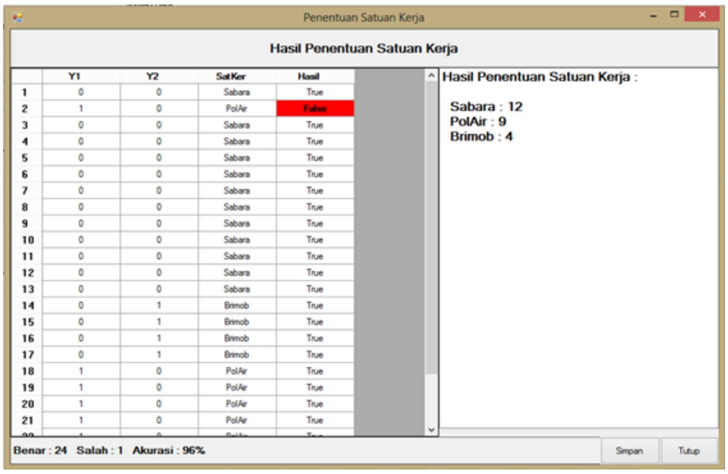


Figure 9. Implementation of the defined interface

RESULT AND DISCUSSION

In this study, the results obtained are that this will explain the test results in the research of the Satker system. There are several factors that can affect system performance in order to produce good output, namely learning rate value = 0.0001, momentum = 0.95, maximum epoch, and the number of hidden layers = 1 and its neurons (10,12,13,14,15,16,17,18,19,20) The trials conducted in this study were to determine how the influence of network architecture and parameter value settings to get optimal results. There have been several experiments conducted, and the results used as an initial reference are to compare the error target with a tolerance of 0.1 with 0.01. The process is terminated if the value of the cost function or performance function is less than or equal to the error target. The results of training with a tolerance of 0.1 can be seen as shown in figure 11. The parameter settings used in the first test can be seen as in Table 12.

No	Neuron	Epoch	SSE	Durasi	Runtime (detik)
1	10	189277	0.009999939	21.05.801	2105801
2	12	170918	0.009999960	25.15.529	2515529
3	13	163122	0.009999963	27.35.425	2735425
4	14	165418	0.009999948	30.45.425	3045425
5	15	176950	0.009999968	36.07.302	3607302
6	16	117119	0.009999941	14.02.790	1402790
7	17	168253	0.009999906	40.12.525	4012525
8	18	186654	0.009999956	36.33.236	3633236
9	19	166231	0.009999952	45.07.079	4507079
10	20	182709	0.009999983	56.05.235	5605253

Figure 11.

Table of training results of the number of neurons with 1 hidden layer target 0.1

No	Neuron	Epoch	SSE	Durasi	Runtime (detik)
1	10	20137	0.09999531	00.59.066	59066
2	12	19713	0.09999914	01.24.034	124034
3	13	22622	0.09999487	02.20.097	220097
4	14	20058	0.09999932	03.38.015	338015
5	15	22483	0.09999866	04.43.493	443493
6	16	21681	0.09999451	04.00.083	400083
7	17	23614	0.09999370	04.52.089	452089
8	18	19949	0.09999971	04.26.077	426077
9	19	23953	0.09999610	04.37.595	437595
10	20	18272	0.09999978	04.11.721	411721

Figure 12.

Table of training results of the number of neurons with 1 hidden layer target 0.01

The tests conducted showed that with a target of 0.01 the training process runs longer than the target of 0.1. The number of neurons in the hidden layer with the smallest SSE value was obtained at 17 neuron counts, both in the first and second experiments. SSE takes the average squared value of the error that occurs between the output and the target.

In testing with the learning rate parameter (α) the effect on the number of iterations in JST training can be known by training JST by varying the learning rate parameter (α). Several corresponding learning rate (α) values are used between 0.0001, 0.0002, 0.00015, with a momentum of 0.95 and an error tolerance of 0.1, number of neurons 17, presented in figure 13 and figure 14.

Learning rate (α)	Epoch	SSE	Durasi	Runtime (detik)
0.0001	23044	0.09999206	05.24.561	524561
0.0002	11822	0.09999527	01.57.028	11822
0.00015	20649	0.09999619	05.11.967	511967

Figure 13 Table of influence between LRs with target 0.1

Learning rate (α)	Epoch	SSE	Durasi	Runtime (detik)
0.0001	168253	0.009999906	40.12.525	4012525
0.0002	81866	0.009999932	20.57.933	2057933
0.00015	113651	0.009999937	28.22.333	2822333

Figure 14 Table Influence between LR and target 0.01

Based on the test results with a learning rate (α) parameter of 0.0001 and a target of 0.1 for the same number of neurons, the number of iterations that occur is decreasing or in other words convergent conditions are happening faster. However, if the learning rate (α) is targeted at 0.01, then the number of iterations will increase, this will result in longer convergent conditions.

Testing with momentum parameters, providing momentum parameters in the JST system serves to prevent the system from getting stuck inside the local minimum. The momentum values that are trying to be tested are: 0.75, 0.85, and 0.95 as in figure 15 and figure 16

LR	Momentum	Epoch	SSE	Durasi
0.0001	0.75	100040	0.09999951	24.15.455
	0.85	72987	0.09999875	17.47.025
	0.95	20406	0.09999459	04.56.663
0.0002	0.75	64832	0.09999932	16.07.646
	0.85	31391	0.09999987	07.48.118
	0.95	98460	0.09999918	20.22.150
0.00015	0.75	48174	0.09999972	06.46.289
	0.85	39173	0.09999942	08.30.355
	0.95	13963	0.09999561	03.16.798

Figure 15 Table Momentum testing results with a target of 0.1

LR	Momentum	Epoch	SSE	Durasi
0.0001	0.75	741411	0.009999993	03:07:27:382
	0.85	499164	0.009999981	02:12:04:353
	0.95	168253	0.009999906	40:12:525
0.0002	0.75	511299	0.009999987	02:08:16:626
	0.85	250185	0.009999999	01:02:52:241
	0.95	85462	0.009999925	24:46:132
0.00015	0.75	583687	0.009999984	02:55:10:996
	0.85	342527	0.009999906	01:39:25:946
	0.95	106594	0.009999900	26:53:692

Figure 16 Table Momentum testing results with a target of 0.01

Based on the test results with momentum with a target of 0.1 and a target of 0.01 shows that the epoch with the smallest SSE value is at momentum with a value of 0.95 with an LR value of 0.0001. In momentum testing with target 0.01 it takes longer to converge compared to target 0.1. Based on the test results of Table 5 and Table 6 with a momentum value of 0.95, with LR 0.0001 the system can accelerate the convergence process with error values that are already relatively small from other LRs.

In the system analysis, it is also known that based on the results of the experiments conducted, the parameter values used to obtain optimal weights, iterations and minimum SSE for the testing process in JST training, researchers use the following parameters:

a. Bias = 1.
b. Learning rate (α) = 0.0001.
c. Momentum = 0.95.
d. Number of hidden layers = 1 layer.
e. Number of neurons = 17.
f. Error = 0.1.

The testing process is carried out manually by sorting 25 data from 100 data. The data used for testing is new data that is not included in the training. The accuracy of the test results is greatly influenced by the weight of the training results, which shows the ability of the network to recognize the patterns that have been given. Information on the test results of determining work units using JST FRNN with its network target.

The results of testing with the JST model fully recurrent neural network show that the system has not been able to recognize all data patterns well seen in the 2nd data has not been recognized, so the accuracy value of each reaches 96%. Tests were also carried out on 30 real data using no target, pattern recognition data results of 25 data, and 5 data not recognized, with an accuracy rate of 83.33%.

The application of FRNN for the determination of work units for new police non-commissioned officers is a new alternative for the police, especially the Kupang SPN to determine work units (Hotman, 2015). Based on the data of the Introduction to educational orientation (POP), KU (general competence), KUT (main competency), KKS (special competence), Latnis value, Mental value, and Samjas value that have been entered into the system, the results of determining the work unit can be displayed as shown in Figure 17.

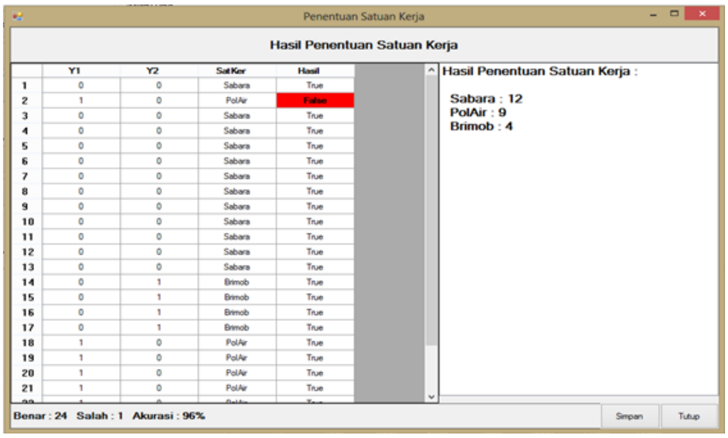


Figure 17 Results of determining work units from FRNN-based systems.

CONCLUSION

Based on the results of research and discussions that have been carried out, the following conclusions are obtained Based on the experimental results of testing the influence of JST parameters on iteration and SSE, to get the most optimal weight for the testing process in JST training using 1 hidden layer with 17 neuron units, LR of 0.0001, momentum 0.95, with an error target of 0.1.

In this case, the FRNN JST model can recognize 24 new data from 25 data tested. The unrecognizable data is on the 2nd data, so the accuracy achieved is 96%.

The application of JST FRNN for the introduction of real data as many as 30 new data, data that cannot be recognized in the 9th, 11th, 17th, 27th and 29th data, so that the accuracy achieved is 83.33%.

The application of the JST FRNN model for work unit determination classification cases is a new alternative that can help the Kupang SPN to classify work units for new police officers based on the value of competence possessed to be placed in the appropriate work unit

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