Joko_Sutopo_Identify student stress level detection with backpropagation method

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Identify student stress level detection with backpropagation method

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Abstract. Students as young generation and agent of change are required to be always active in academic and non-academic activities; therefore in the process, they will encounter various obstacles and obstacles. Not infrequently it makes them experience stress. The fact that students often do not know the situation that they are experiencing stress. So there is a need for a system to detect students stress levels to reduce the adverse impacts. With the development of Backpropagation method as a guided learning method combined using Depression Anxiety and Stress Scale 42 (DASS 42) as a scale to identify stress levels in students based on emotional, physical, and behavioural variables. It is expected to be a reference in helping students to detect the level of stress they are experiencing. Also, the use of Backpropagation method is used to see the level of accuracy of data in the system.

1. Introduction

In the modern era, today people are required to always think and act quickly and precisely in various ways. One example is in solving the problem. Someone who cannot solve the problem well will arise another problem. Similarly, students who often face a variety of matters other than college such as family affairs, affairs, financial affairs and so forth. It makes students vulnerable to stress.

Based on the Great Dictionary of Indonesian Language, stress is a disorder or a mental and emotional disorder caused by external factors; tension. While the other definition of stress is "a substantial imbalance between demand (physical and psychological) and response capability, under conditions where failure to meet that demand has the importance of consequences"[1].

However, the problem that often happens is that students often do not know at this time they are experiencing stress. By this, the researchers wanted to make a system of detection of stress levels in students to reduce the adverse effects it caused.

Backpropagation method to detect resistance to stress with two output layer result that is good endurance and lousy endurance with a value of learning constant 0,75 with some hidden layers counted 60. With iteration equal to 10334 and sum Sum Error (SSE) equal to 0, 0987129683. The results obtained 100% accuracy in the test data train and 75% on the testing of new data[2].

Artificial neural networks can predict stress resilience with an accuracy of up to 81.25% accuracy level obtained after 5000 iterations in the training process by eliminating the disturbance factor of anxiety tolerance[3].

From the two research above researchers interested in creating a system of stress level detection of students with a dynamic system to test the accuracy of backpropagation with precise weights.

2. Method

Backpropagation Neural Network is a training algorithm trained using guided learning methods. When the pattern is assigned to the network, the weights are modified to minimize the difference between the output pattern and the desired pattern. Artificial neural network training with backpropagation consists of two processes, namely forward propagation and propagation, both propagation applied to the network for each pattern given during the training network[4]. Can be seen in Figure 1.

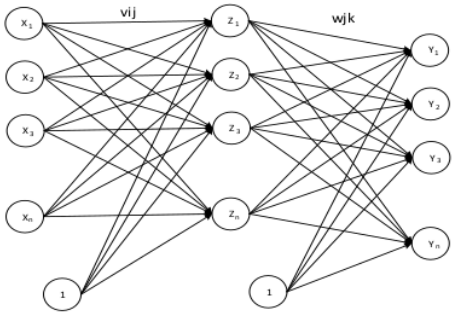

Figure 1. Model Backpropagation Neural Network

Where X is the input layer, v is the weight of the input layer to the hidden layer, w is the weight of the hidden layer to the output layer, and Y is the output layer.

In Backpropagation network training, when the network gets input (input) as training data, then the pattern will go to every unit on the hidden layer then it will be forwarded to the output layer units. The temporary output of the hidden layer is passed to the output layer, and the output layer will produce a temporary output that will be compared with the expected output or target output. When the output of the resulting output layer is not equal to the target output, then the difference between the temporary output and the target output will be forwarded back to the hidden layer and passed to the input layer. In the training process the training rate is used (learning rate) whose value is in the range of 0 to 1, its function is to speed up the training process. The network training algorithm with Backpropagation includes three stages, namely the feedforward stage of input training pattern, backpropagation of related error, and weight adjustment[5]. In the backpropagation network, the commonly used activation function is the double sigmoid function to obtain the output value at intervals 0 through 1, as shown in the following equation[6].

$$f(x) = \frac{1}{1 + \exp^{-x}}$$

3. Result And Discussion

The system to be built in this study is an application that can detect stress levels in students. In this research, the steps performed before the training and testing process is taking data using questionnaires. The data taken are data from the research object, in this case, are students and answered based on what they experienced.

The detection of students' stress levels can be detected using the scale of Depression Anxiety and Stress Scale 42 (DASS 42) by Lovibond & Lovibond[7]. Measuring tools are designed to measure negative emotions consisting of depression, anxiety and stress. DASS 42 has met the requirements of many professional researchers and doctors[8].

DASS 42 contains 14 items for each scale divided into several subscales, and there are 2-5 items with similar content. The scale of depression rates dysphoria, despair, devaluation of life, self-denial,

lack of interest, anhedonia, and weakness. Anxiety scale assesses the effects of subjective experience, situational anxiety, intimate arousal and skeletal muscle affecting anxiety. The stress scale assesses nervousness, impatience, difficulty relaxing and irritability or anxiety and excessive sensitivity or expression[9].

Levels of depression, anxiety, and stress are calculated by accumulating weights for related items. The items of the scale of depression level are 3, 5, 10, 13, 16, 17, 21, 24, 26, 31, 34, 37, 38, 42. The anemic scale scale items are 2, 4, 7, 9, 15, 19 , 20, 23, 25, 28, 30, 36, 40, 41. Item-scale stress levels are 1, 6, 8, 11, 12, 14, 18, 22, 27, 29, 32, 33, 35, 39[9]. The scale in DASS 42 has been shown to have a high consistency in measuring the current state as well as changes over time, so the instrument does not require a validity test or an item feasibility test in a questionnaire to explain a variable[10]. Nor test the reliability or degree of determination between the data that occurs on the object of research with the power that can be reported by the research. Thus there is no data deviation between the reported data and the actual data occurring on the research object[11].

In the method of Artificial Neural Network (ANN) Backpropagation, there is a data train and test data. Train data is data inputted as a knowledge base on Backpropagation while test data is a test based on trainer data that have been inputted.

3.1. Train Data

Train data is data entered in the form of answers, each question and targets to be achieved by the admin as a system manager. Then the data will be stored in the database on the data Input data train, after that, the data stored in the database can be accessed back on the page Train data to then be trained by entering the number of hidden layers, learning constant, MSE, maximum iteration, and iteration multiples. Here is a table of calculation of trainer data using 125 training data, 14 number of hidden layer, 0,1 learning constant, 0,00001 MSE, 100000 maximum iteration and multiple iterations of 20. All data will be processed using backpropagation method and generate weight from the input layer to hidden layer, the weight of the hidden layer to the output layer, the weight of the bias to the hidden layer and the weight of the bias to the new output layer. The system also displays MSE weight changes, as well as the number of iterations stopped.

Table 1. Table Weight from the Input layer to Hidden Layer

No.	Weight													
1	-1.728	0.867	-1.317	0.653	0.357	-0.489	0.440	-2.236	-1.222	0.569	-2.796	-1.780	1.143	-0.416
2	-3.317	1.841	-1.138	1.802	-0.666	-2.142	-2.220	-1.650	-1.485	4.323	-1.189	0.274	1.546	1.565
3	0.833	1.096	0.741	1.700	0.092	-1.316	3.914	-0.716	-1.133	3.405	0.525	-0.841	-0.595	0.314
4	-2.707	0.030	0.610	0.543	0.590	-1.375	-4.030	1.555	-0.969	-3.842	1.517	0.864	0.979	0.781
5	0.909	0.776	-0.421	0.745	0.831	-0.650	1.660	1.022	-0.409	-0.002	-0.097	0.579	-2.363	1.167
6	-0.849	0.199	0.206	0.863	0.790	-0.562	2.697	1.149	-1.221	3.751	1.080	-2.392	1.140	1.042
7	-1.178	0.135	-0.168	1.516	0.005	-0.421	0.250	-1.943	-0.570	-1.249	-0.032	0.323	0.021	1.629
8	-1.571	2.060	-1.394	0.565	0.584	-0.766	-1.890	-0.023	-1.632	-2.081	-1.592	-0.754	-0.966	1.367
9	1.242	0.341	-1.267	0.526	0.651	0.164	0.297	-0.613	-1.741	2.659	-0.758	-0.550	-1.631	0.278
10	-0.116	1.067	-2.711	1.194	0.463	-0.771	-2.001	1.203	-1.692	-0.400	-0.550	1.993	-0.434	-0.103
11	0.505	1.371	-0.379	0.917	1.084	-0.214	-2.674	1.093	-0.706	-1.943	-0.548	0.428	0.667	-0.289
12	-0.412	-0.015	-0.462	1.213	0.938	-1.820	-0.759	0.865	-0.263	1.473	-0.423	-1.129	1.197	0.653
13	-1.643	0.846	-1.967	-0.121	0.331	0.022	2.094	0.299	-1.144	-2.164	0.300	-1.696	0.227	0.771
14	0.294	1.593	-0.802	1.050	1.042	-0.398	1.071	0.229	-1.544	0.214	-2.336	0.777	1.451	-0.082

Table 1 is the new weights of the input layer to the hidden layer (Vij (new)) enabled for use in the process of detecting stress levels.

Table 2. Table Weight of Hidden Layer to Output Layer

No.	Weight													
1	-3.942	4.538	-6.038	-0.399	-0.328	-2.353	-2.769	1.504	-2.148	2.206	-2.262	-2.013	1.187	1.149
2	6.169	-6.785	3.723	3.926	-1.774	-4.899	-1.675	-0.213	-9.094	-0.825	1.313	-0.267	-0.126	2.309
3	-0.931	-3.917	3.995	3.548	0.806	-1.162	6.758	-3.618	-3.053	-6.196	-3.458	2.590	-2.831	1.518

The data in Table 2 are the new weights of the Hidden layer to Output Layer (Wjk (new)) enabled for use in the process of detecting stress levels.

Table 3. Table Weights from Bias to Hidden Layer

No.	Weight
1	5.75386
2	-9.22629
3	7.92610
4	-3.50169
5	1.02849
6	3.34417
7	-1.22816
8	-1.84109
9	7.49963
10	-1.48698
11	1.50860
12	-0.28142
13	0.91447
14	-1.85280

In Table 3. are new weights from Bias to Hidden Layer used in the system

Table 4. Table Weights from Bias to Output Layer

No.	Weight
1	-0.36569
2	-3.36415
3	-0.42528

Likewise in Table 4. are new weights from Bias to Output Layer used in the process of detecting stress levels in students.

Table 5. MSE Table Based on Iterated Numerals

No.	Multiplier to-	Weight
1	1	0.03030557305834287
2	20	0.026787420731454126
3	40	0.02299210154351974
4	60	0.01725853452513551
5	80	0.009956634016006813
6	100	0.004362598692494384
7	120	0.0017409111677501108
8	140	0.0007525841193321099
9	160	0.0003767063297766898
10	180	0.00021844331985040028
11	200	0.0001434187162455801
12	220	0.00010434709217902179
13	240	0.00008285849918778537
14	260	0.00007096673967160838
15	280	0.00006455790166731399
16	300	0.0000602921412803069
17	320	0.00005521936426057831
18	340	0.00004839629670782103

19	360	0.000040642070314035324
20	380	0.00003308735643646435
21	400	0.0000264200709524473
22	420	0.000020768759982307637
23	440	0.000015905165141253812
24	460	0.000011727301548688051
25	471	0.000009849862684394332

From Table 5, it can be seen that the weight of the MSE changes in each iteration and stops at the iteration to 471. Then all the data in the tables above are new weights that are then activated and used to detect students' stress levels. The graph of MSE weight changes can be seen in Figure 2.

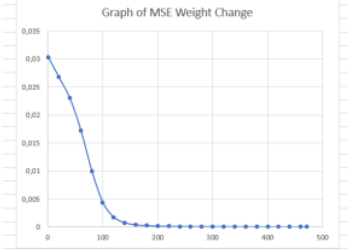

Figure 2. Graph of MSE weight changes

From Figure 1 we can see the change in the graph of MSE weight changes from every iteration multiples.

3.2. Test Data

Test Data is data entered by students in the form of the answer to each question on the system. The answer is then calculated using the backpropagation method with the weight of the input layer to the hidden layer, the weight of the hidden layer to the output layer, the weight of the bias to the hidden layer and the weight of the bias to the output layer enabled. In the prediction table, there are 14 inputs; this is taken from the number of questions that use. Test data from correspondent collected.

From the answers of each correspondent will be directly calculated using the backpropagation method with the active weight on the result page detection. After that the result of the percentage level of accuracy will appear, the calculation of this level of accuracy to see the suitability of the target with the resulting output. See Figure 3.

Figure 3. The accuracy of Test Data

From the results of this calculation, the accuracy of 65.254% of 118 corresponding data received with 14 number of hidden layers, 0.1 learning constant, and 0.00000984 Mean Square Error (MSE) with the total of 125 training data.

4. Conclusion

Based on the results of the analysis, design and implementation of the stress level detection system in students can be concluded that:

a. The stress level detection system for students has been successfully developed with five stress levels including regular, mild, moderate, severe, extremely severe based on DASS 42.
b. This system uses an artificial neural network method with a supervised learning technique that is Backpropagation.
c. Backpropagation supervised learning techniques successfully implemented in this study. The data is divided into two data that is training data and test data. Data were tested as 118 data with 14 number of hidden layer, 0,1 learning constant, and 0.00000984 Mean Square Error (MSE) with a total of 125 practice data resulted in accurate level 65,254% after tested. This percentage may change as the weights are activated.
d. The more train data used, and the lower the Mean Square Error level used, the lower the result deviation to the desired target.

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