Real Time Detection of Employee Satisfaction Level based ANFIS Method and Internet of Things

Mardi Turnip, Cindy Cynthia, Ester Ayu S. Marpaung, Ganang Reza Priambodo, Haposan Daniel Panjaitan and Delima Sitanggang

***Abstract*— Job satisfaction is an important factor in human resource management in an organization. Job satisfaction can affect productivity, performance, and loyalty. In this study, the level of job satisfaction will be predicted based an Adaptive Neuro Fuzzy Inference System model in real time supported by Internet of Things. Based on model validation, the results obtained were that the variables of performance appraisal, work motivation, facilities and work environment, responsibility, and competence has an effect on job satisfaction with an accuracy rate of 97.18%.**

***Index Terms*—ANFIS, Employees, Job Satisfaction, Human Resources.**

I. INTRODUCTION

IN supporting the running activities process in a company cannot be separated from the support of Human Resources (HR). Therefore, it is very important to pay more attention to the level of HR job satisfaction. This is a part of job satisfaction that be able affect productivity, performance and loyalty. However, in its implementation still many shortcomings that make HR dissatisfied. For example, inadequate facilities and inadequate wages. In other words, so that the company's operational activities can run well, the company must be able to measure the level of HR job satisfaction.

Several previous studies, discussed job satisfaction on employee health. The results of the study showing that employee emotional instability such as: job insecurity, worry, and depression affect the value of factors that affect employee job satisfaction [1]-[6]. In addition, there is also study showing that fairness in the employee performance appraisal system is an important element that influences employee motivation and performance. Employees must feel motivated and be treated fairly without gender discrimination in performance appraisal. This will encourage employees to work better and increase employee job satisfaction so that it will increase organizational productivity [7]-[9]. There is also study that discusses whether leadership behavior influences employee job satisfaction. The study results obtained showing that the most important variable in supporting employee satisfaction is leadership. The quality of the leader is considered as the most important factor in the success or failure of a company [10]-[15]. There is also study that discusses the influence of the work environment on employee job satisfaction. The study results show that, support from the work environment and company such as: work safety, health, ranking, and salary guarantees are one of the factors that affect employee satisfaction which has an impact on employee performance in a company [16]-[20].

In this study, a measurement is carried out to determine the level of employee satisfaction using the Adaptive Neuro-Fuzzy Inference System (ANFIS) method.

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II. RESEARCH METHODS

A. Data Collection Methods

Data collection is carried out to obtain the information needed in order to achieve research objectives. In this research the data collection method is used a questionnaire. Questionnaires are data collection techniques which are carried out by giving a set of written questions to respondents' answer, can be given directly or by post or the internet.

The sampling technique is used population-wide, by dividing the data into training data and test data. The test size is derived from comparing the mean errors for different membership types. If proven ANFIS can be used to process work transcripts [21]-[22].

B. ANFIS Method

The ANFIS method has the ability of fuzzy logic and artificial neural networks (ANN). Fuzzy logic has advantages in modeling the qualitative aspects of human knowledge and decision-making processes by applying the rule base. While ANN has advantages in recognizing patterns, learn and practice in solving a problem without needing for mathematical modeling. An ANN can also work based on historical data which is entered into it and can predict future events based on these data. So ANFIS has both capabilities.

The ANFIS network consists of several layers [23]. The first layer is the fuzzification layer. The output of each neuron is the degree of membership given by the input membership function. Where Z is the input, in this case Z = {Zt-1, Zt-2} and {c, σ} are the parameters. If the values of these parameters change, the shape of the curve will also change. These parameters are

usually called by the name of the premise parameters. Suppose the Gaussian membership function is given as:

$$\mu[Z] = e^{-\frac{1}{2}\left(\frac{z-c}{\sigma}\right)^2} \quad (1)$$

In the second layer, fixed neurons (symbolized by Π) are the product of all the inputs which are normally used by the AND operator. The result of this calculation is called the firing strength of a rule. Each neuron represents the k rule, as follows:

$$w_k = \mu_{A_k} \cdot \mu_{B_k} \quad (2)$$

In the third layer each neuron in this layer is a fixed neuron (given the symbol N) which is the result of calculating the ratio of the k firing strength (wk) to the sum of the overall firing strength of the second layer. The result of this calculation is called normalized firing strength, as follows:

$$\bar{w}_k = \frac{w_k}{w_1+w_2}, i = 1,2 \quad (3)$$

The fourth layer is a neuron which is adaptive to an output. Where $\bar{w}k$ is the normalized firing strength of the third layer and qk, rk, and sk are the parameters on the neuron. These parameters are usually called consequent parameters, as follows:

$$\bar{w}_k f_k = \bar{w}_k (q_k Z_{t-1} + r_k Z_{t-2} + s_k) \quad (4)$$

The fifth layer in the form of a single neuron (given the symbol Σ) is the result of the sum of all outputs from the fourth layer, as follows:

$$\sum_k \bar{w}_k f_k = \frac{\sum_k w_k f_k}{\sum_k w_k} \quad (5)$$

Each form of ANFIS consists of several layers as shown in Fig. 1.

C. Data Processing Methods

The first step is carried out by analyzing the problems to be discussed, namely determining the level of job satisfaction of non-academic college employees.

Then the next step is to collect data by distributing questionnaires to employees from various tertiary institutions. After that the data is processed by changing each value of the questionnaire's answer with a number and separate each variable value into dataset and test data. The next step will be carried out by using ANFIS. At the data training stage, the dataset will be loaded into ANFIS. This data training will show the root mean square error of the data. Then at the data testing stage it shows the accuracy of ANFIS in testing the data. In the final stage, values will be displayed based on the range which shows the results of each variable. The scheme of general method for satisfaction level detection of an employee by management is given in Fig. 1.

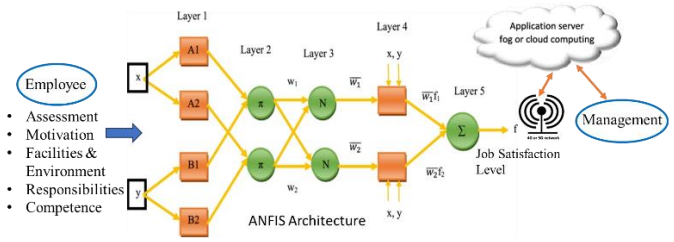

Fig. 1. The Scheme of Employee Satisfaction Level based ANFIS Model and IoT protocol.

III. Experiment Results

The data obtained coming from several professions of several universities. Each answer obtained from the results of distributing the questionnaire is given a value of five to one according to the answers which there are later summed according to the specified variable and output. After obtaining the total value of each variable, the data will be processed using the ANFIS method.

Data processing is trained in two classes, namely train data and test data by using grid partition with member function 3 3 3 3 3. The 100 epochs used in the train data show a root mean square error of 0.83043. The testing data carried out produces output that shows a comparison between the train data (blue circle) and fis output (red star). There are 41 mutually integrated comparisons between train data and fis output, this shows which the data tested has accurate results. Then there are 18 close comparisons between train data and fis output, this shows which the data tested has almost accurate results. There is 1 comparison which is far from each other between train data and fis output, this shows that the data tested has inaccurate results, as shown in Fig. 2.

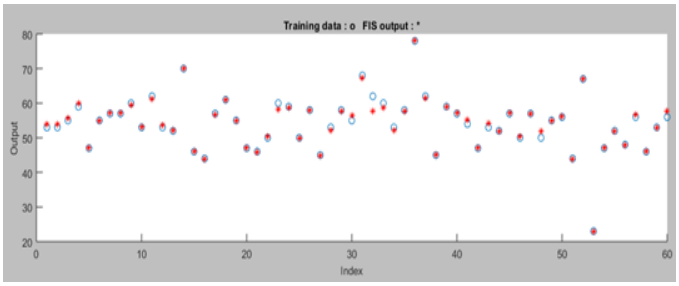

Fig. 2. Testing Data.

The structure of consists 5 layers. The first layer has 5 inputs. The second layer is Fuzzification or the process of mapping crisp (numeric) values into fuzzy sets and determining the degree of membership in the fuzzy sets, in processing this data every single input has three membership functions. The third layer is the determination of weights. The fourth layer is weight normalization. The fifth layer is the calculation of fuzzy output levels, and the last is defuzzification.

A prediction model to determine the level of employee job satisfaction is built by utilizing ANFIS using five inputs and one output as test data and train data. The ANFIS used by using the Sugeno method which consists of five inputs in the form of: performance appraisal, work motivation, facilities and work

environment, responsibility, and competencies, each of which has three neuros, as well as one output in the form of job satisfaction on the fuzzy interface. Based on the range, each variable is categorized into three classes, namely: Not Satisfied, Quite Satisfied, Satisfied. For example, in the performance appraisal variable there are parameters 16 to 27. This figure means that if the value of the performance appraisal variable is between parameters 16 to 27 then the data will be categorized as Not Satisfied (NS). If the value of the performance appraisal variable is between the numbers 28 to 38 then the data will be categorized as Quite Satisfied (QS), and if the variable value is between the numbers 39 to 49 then the data will be categorized as Satisfied (S).

The rules view shows the results of the comparison input to output variables. On the performance appraisal input obtained a value of 28.5 = Quite Satisfied, work motivation obtained a value of 31.5 = Quite Satisfied, facilities and work environment obtained a value of 32.5 = Quite Satisfied, responsibility obtained a value of 35 = Quite Satisfied, competence obtained a value of 36.5 = Quite Satisfied, which if each variable is accumulated will produce a job satisfaction output with a value of 65.8 = Satisfied, if each variable is accumulated it will produce a job satisfaction output with a value of 65.8 = Satisfied, as shown in Fig. 3.

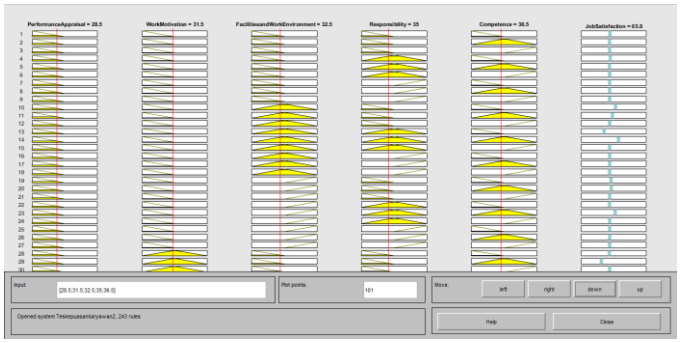

Fig. 3. Rule Viewer.

There is a result of a combination of five inputs in the class of each dependent variable which produces 243 possibilities, which are obtained from a scale of 35. In the experiments have been carried out, the developed structure of the ANFIS model is 5 15 243 243 1. Number 5 as the sum of input variables, 15 as the sum of each member function, 243 as the sum of possibilities obtained from the input, 243 as the sum of rules obtained from the output, and 1 as the output.

Measuring model the level of job satisfaction serves to measure the level of job satisfaction based on the value entered in the input variable. The value entered in the input variables will be calculated, accumulated, and categorized base on three classes, namely: Not Satisfied, Quite Satisfied, Satisfied. For example, the value of 28.5 entered in the Work Assessment variable, a value of 31.5 entered in the variable Work Motivation, a value of 32.5 entered in the Facility and Work Environment variable, a value of 35 entered in the Responsibility variable, and a value of 36.5 entered in the Competency variable will produce an output value in the satisfied category (Satisfied), as shown in Fig. 4.

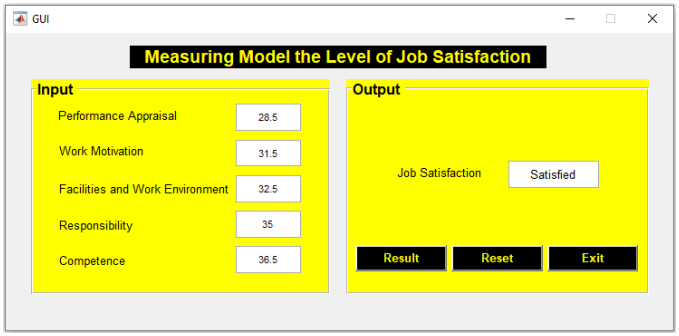

Fig. 4. Measuring Model the Level of Job Satisfaction.

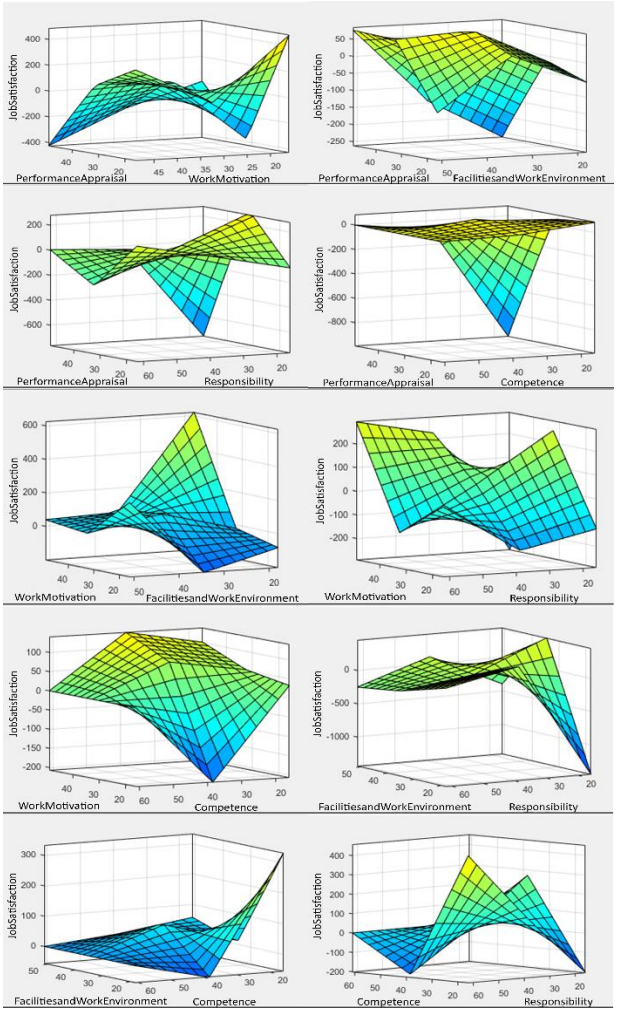

Fig. 5. Magnetization View Surface Effect of Input Parameters to Output.

There are 102 questions grouped based on 6 variables, namely: Work Assessment, Work Motivation, Work Facilities and Environment, Responsibilities, Competence, and Job Satisfaction. Each question generates responses based on the category Very Satisfied, Satisfied, Less satisfied, Dissatisfied, and Very Dissatisfied. The responses obtained from the results of the questionnaires distributed are presented in a Circle Diagram with a total of 100 respondents, shown in Fig. 6. The view surface shows the continuity between the input variable x

and the input variable y. The view Surface works by comparing two inputs to one output based on data on the assessment of employee satisfaction levels. The results on the graphic surface display show a comparison of the variables that greatly determine job satisfaction. The view surface shows that competency and responsibility variables greatly influence job satisfaction. The competency variable at coordinate point 36.5 and the responsibility variable at coordinate point 37 are compared to the output of job satisfaction, it obtained that the value of competence and responsibility produces a prime value of 398, shown in Fig. 5.

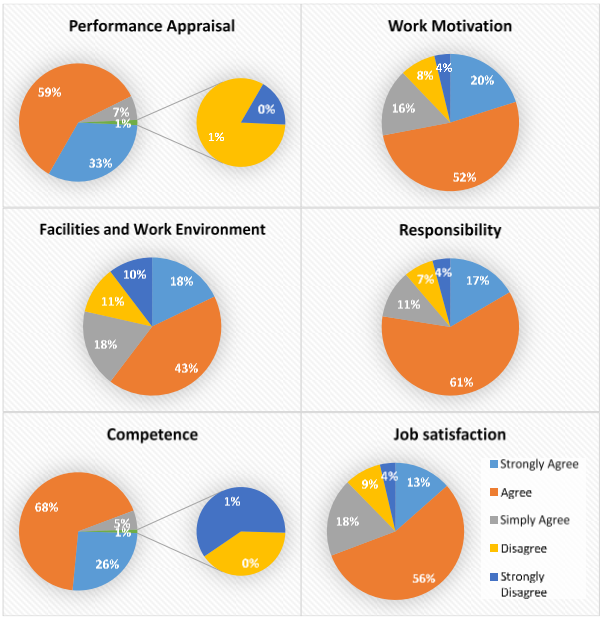

Fig. 6. Magnetization View Surface Effect of Input Parameters to Output.

The results of the data are obtained based on the processing of the model from the data testing process and data testing performed using ANFIS, so producing the best data model. By using as many as three member functions, the level of accuracy of the data in this research is calculated based on the output and results of ANFIS. In this study, 100 respondents are divided into 60% as test data and 40% as train data which will be processed using the ANFIS method. The prediction results show the alignment of the comparison between output and ANFIS' results. Based on the calculation results, it is obtained that the level of accuracy of the data in this research is 97.18% as shown in Fig. 7.

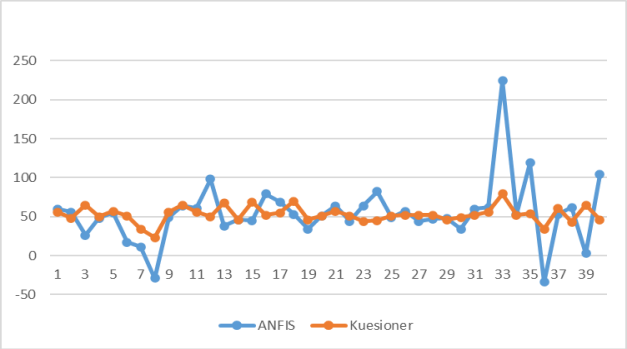

Fig. 7. Magnetization Comparison of ANFIS and Questionnaire results.

IV. Conclusion

Based on the study, the findings resulted in the performance appraisal variable, work motivation, work facilities and environment, responsibility, and competence affect job satisfaction with an accuracy rate of 97.18%, with the value of each variable of 28.5, 31, 32.5, 36.5 and 65.8, respectively.

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