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Implementation ANFIS Method for Prediction Needs Drug-based Population Diseases and Patient

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Abstract—Prediction needs a drug that not optimal at the hospital have to impact at services medical as well as economically, the cause will overbalance as well as deficiency stock, at this research, Adaptive Neuro-Fuzzy Inference System implemented for prediction needs drug with applies Genetic algorithm for optimizing ANFIS parameters. Training process done at dataset using drug sourced from note medical from year 2015 until year 2017, while testing using dataset year 2015 for prediction year 2016 and dataset year 2016 for prediction 2017, framework analysis training and testing applied at ANFIS method and GA-ANFIS and evaluation with RMSE method of 0.4765 and ANFIS of 0.6598, so that GA-ANFIS very accurate compared ANFIS.

Keywords—ANFIS method, prediction needs drug, population diseases patient

I. INTRODUCTION

The management of drugs the good guarantee always availability drug any time need requiring, in sufficient quantities, guaranteed quality and price affordable for support service quality. One of function management of drug is selection to a drug that's really for most of the population based on a pattern of disease which exists. The selection process is the first phase that very determines so that can determine how many item drugs that will consume in the future. Planning of drugs is an activity process in the selection of kinds, amount, and price drug appropriate and budget. Generally planning process needs of drug-based aggregate data needs from fields medic service like polyclinic, pharmacology, radiology, and the others, needs data of drug will collect at logistic part for turned over to part planning a drug, part planning doing selection needs drug for period one next year. Uncertainty needs drug caused disease population and amount patient can change appropriate which condition data volume diagnostic patient, so that need an automatic way for choose needs drug appropriate development diseases [1].

38 Application Adaptive Neuro-Fuzzy Inference System (ANFIS) method used for forecasting or predict [2], [3] and [4], cause have high accuracy level [5], however learning ANFIS method can stuck into solution which is local optimal, where algorithm only find solution most optimal at part just certainty, or not represent whole room solution, so that take effect for accuracy prediction[6]. Some result research has proven success optimization training ANFIS with apply some algorithm, like Pattern Search Algorithm (PSA) with ANFIS doing by [6], combination K-Means with ANFIS proposed into [8], Modified Genetic Algorithm (MGA)-ANFIS [9], Genetic Algorithm (GA)-ANFIS [10]-

[11], Different Evolution (DE)-ANFIS by [12], [13], apply Particle Swarm Optimization (PSO)-ANFIS and [14] execute research ratio accuracy PSO-ANFIS and GA-ANFIS, optimization metaheuristic or evolution at net ANFIS learning can upgrade accuracy result[15].

II. LITERATURE REVIEW

In this result we proposed combination GA for upgrade net learning ANFIS process on sales dataset for prediction need drug based on disease population, with the good prediction result will very influence decision making for upgrade medical service and budget needs drug more optimal

In recent years, application forecasting model or predict many proposed researchers like served by [17] propose Deep Neural Networks (DNN) to predict land water, with analyze application and performance four models compute Deep Learning modern to predict level land water with consider variability temporal from flow, rainfall, and ambient temperature, Generative Adversarial Networks Time Series model [18] proposed to predict daily sales in hospital. Recently enhancement accurate ANFIS method in forecasting has served in many creative with propose Genetic Algorithm method [10] on ANFIS net, [13] propose Particle Swarm Optimization (PSO) method at ANFIS. Yaseen et al [19] integrate ANFIS- method at three algorithm evolution different is GA, PSO and Differential Evolution (DE) to predict low time rainfall. Combination ARIMA by ANFIS served on creative [20], Ceylan et al [14] and Rezakazemi et al [11] doing comparison performance ANFIS. [21] propose hybrid ANFIS model-based decomposition mode empirical to predicted stock price in Taiwan Capitalization Weight Stock Index (TAIEX) and stock Hang Seng Index (HSI), and [22] comparison Artificial Neural Network (ANN) model with ANFIS to model and predict temperature in machining while creation [23] present comparison three model SVM, ANN and ANFIS to estimate radiation sun global every day in the environment sub moisturizer warm.

The creation [23] presents forecasting model sales medicines with comparison factors that impact with apply Random Forest method. In this paper we contribute to forecasting needs medicine optimally based diseases population, prediction ANFIS model training using the GA algorithm to increase accurate prediction.

34 III. PROPOSED METHOD

A. Adaptive Neuro-Fuzzy Inference System

ANFIS is approach Neuro-Fuzzy that introduced by [16] [17] that explored a fuzzy system model [18] and can use for control application, prediction or forecasting. ANFIS architecture same that Neural Network used to optimize fuzzification parameter value. Neuro-Fuzzy consists of five layers process. At the first parameter, layer is parameter from association membership fuzzy that nature non-linear toward output system.

The training process at parameter using Error Back-Propagation for influence the parameter's value. At the fourth layer, a parameter is a linear parameter to output system that arranges rule base fuzzy. At this fourth layer using the Least-Squares Estimator method, like figure 1.

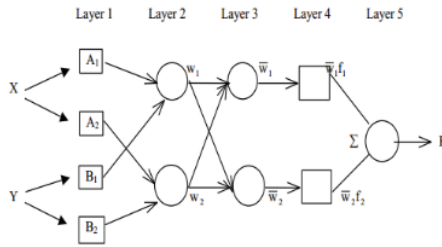


Fig. 1. ANFIS Net Architecture [16][17]

Phase training method ANFIS as follows:

layer 1: Every knot ³³his layer is adaptive knot with knot :

$$\begin{aligned} O_{1,i} &= \mu_{A_i}(x) \text{ for } i=1,2 \\ O_{1,i} &= \mu_{B_{i-2}}(x) \text{ for } i=3,4 \end{aligned} \quad (1)$$

With x, y is ³²put knot to- i and μ_{A_i} and $\mu_{B_{i-2}}$ is value linguistic. $O_{1,i}$ is membership degree fuzzy set $T(A)=\{A_1, A_2, B_1, B_2\}$ with A_1, A_2, B_1, B_2 is linguistic variable. Membership function that used is gbell.

$$\mu_{A_i}(x) = \frac{1}{1 + \left\{ \left(\frac{x - c_i}{a_i} \right)^2 \right\}^b} \quad (2)$$

Layer 2: Multiplication operator from fuzzy rule at this knot is AND.

$$O_{2,i} = w_i = \mu_{A_i}(x) \cdot \mu_{B_i}(y) \text{ for } i=1,2 \quad (3)$$

With w_i is degree activation at knot to- i

Layer 3: At knot to- i counted ratio from rule membership degree to- i with sum of rule membership degree.

$$O_{3,i} = \bar{w}_i = \frac{w_i}{w_1 + w_2} \text{ with } i=1,2 \quad (4)$$

Layer 4: Every layer is adaptive knot

$$O_{4,i} = w_i f_i = w_i(p_i x + q_i y + r_i) \quad (5)$$

Layer 5: Is a knot single that count output with all signal input

$$O_{5,i} = \sum \bar{w}_i f_i = \frac{\sum_i w_i f_i}{\sum_i w_i}$$

B. Genetic Algorithm

The Genetic Algorithm is searching heuristics evolution algorithm that depends on natural selection and genetic science. Genetic algorithms work with a population that consists of individuals that where each can represent a solution that may maybe for a problem which exists and provide random searching that used for a complete optimization problem. GA using information which is available for directing to an area that performs very good in the field of search. Basic technique GA designed for simulation process in the natural system, an evolution that required [14].

Naturally, competition between individual to resource which is insufficient always leads to appearance strongest individual that dominates most weak. For GA which represents a solution for certain problems, there is a group in the searching area. For continue genetic analogy, at individual to resemble chromosome and variables represent gen. However, every solution was given expediency score that presenting the ability "competition" individual at [19].

C. Dataset

Need of data for training and testing ANFIS and GA-ANFIS based from a dataset of research [8] consist of attribute gender, age patient, ICD code, long stay, stock-based note data medical patient from on year 2015 until on year 2017. Input data the year 2015 will used for prediction at the year 2016 and compare result ANFIS prediction with actual data the year 2016 and so on until data ratio prediction the year 2017 with actual data 2017.

D. Calculation Accuracy

Result prediction ANFIS method-based training and testing using Root Mean Square Error (RMSE). RMSE is an alternative method for forecasting technique evaluation. If value RMSE getting smaller, then estimate model or variable more valid.

$$RMSE = \sqrt{\frac{\sum_{i=1}^n (y_i - \hat{y}_i)^2}{N}} \quad (7)$$

IV. RESULT AND DISCUSSION

At this research model that proposed show at fig. 2, for upgrade result accuracy prediction ANFIS model, GA method implementation for upgrade performance ANFIS and minimize error level with adjusting and optimizing membership function from inference system type of fuzzy Sugeno. In this research, Gaussian applied as a membership function as that recommended by many researchers. At table 1 presents parameter ANFIS algorithm and GA-ANFIS that used for prediction needs drug optimal.

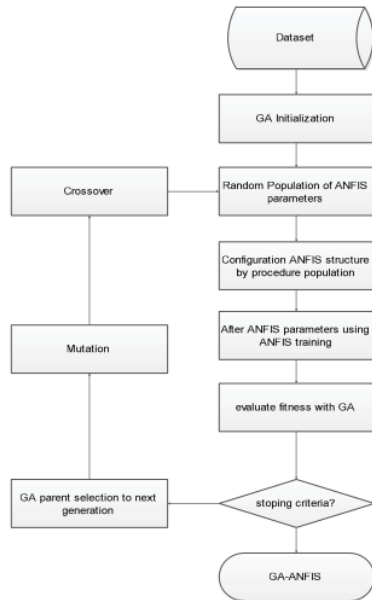


Fig. 2. GA-ANFIS Architecture

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TABLE I. PARAMETER MODEL

Parameter	Description/Value
ANFIS Model	
Fuzzy structure	Sugeno-type
Initial FIS for training	Genfis3
Maximum Iterations Number	1000
Number of fuzzy rules	34
Input MF Type	Gaussian('gaussmf')
Output MF Type	Linear
Initial Step Size	0.01
Step Size Decrease Rate	0.9
Step Size Increase Rate	1.1
GA-ANFIS Model	
Population Size	26
Maximum Iterations Number	1000
Crossover Percentage	0.4
Mutation Percentage	0.7
Mutation Rate	0.15
Selection Pressure	8
Gamma	0.7
Number of fuzzy rules	34

GA-ANFIS model developed at Matlab software for expand ability prediction needed drug, some data show at table 2 with testing phase to do learning rate optimal with using 50% from total data.

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TABLE II. DATA SAMPLE YEAR 2015

No	Medicine	Month												Total
		1	2	3	4	5	6	7	8	9	10	11	12	
1	ACILAZ 30 MG KAPSUL	37	21	22	42	94	04	14	18	33	33	71	18	82
2	ACYCLOVIR 400 MG TABLET	34	28	45	44	59	74	24	44	29	14	29	01	101

3	ACYCLOVIR 5% CREAM	14	31	81	83	15	15	23	12	10	29	77	0
4	ALBOTHYL GEL	36	16	16	15	80	30	21	82	64	23	50	69
5	ALBUMINAR 25% 100 ML INJEKSI	20	11	12	95	73	44	24	12	24	71	39	4
6	ALCO ORAL 15 ML DROPS	15	80	71	14	52	11	71	78	12	27	53	2
7	ALINAMIN F INJEKSI	45	17	55	17	39	11	11	11	39	68	77	60
8	ALINAMIN F TABLET	27	44	40	14	33	13	63	78	61	24	48	8
9	ALLUPURINOL 100 MG TABLET	61	27	11	21	48	11	11	29	24	65	53	3
10	ALLUPURINOL 300 MG TABLET	11	14	42	80	22	22	22	22	20	84	20	4
11	ALPRAZOLAM 0.5 MG TABLET	19	36	13	76	14	81	48	40	53	55	35	5
12	ALPRAZOLAM 1 MG TABLET	13	22	12	11	95	22	28	75	23	56	06	1
13	AMARYL 3 MG TABLET	38	52	13	32	88	61	92	18	33	26	83	3
14	AMARYL M 1/250 MG TABLET	42	11	12	28	21	50	11	52	24	77	26	6
15	AMARYL M 2/500 MG TABLET	15	67	41	75	77	97	72	82	13	81	33	3
16	AMBROXOL 60 ML SIRUP	21	84	61	33	13	27	32	25	16	09	16	1
17	AMINEFRON TABLET	66	54	72	20	21	23	39	35	73	37	15	1
18	AMINOFUID 1000 ML INFUS	42	88	25	29	52	16	63	54	35	43	59	9
19	AMINOFUID 500 MG INFUS	42	69	59	14	09	14	12	33	57	94	11	1
20	AMINOFUSIN HEPAR INFUS	10	91	23	39	32	53	34	15	91	78	11	1
21	AMINOFUSIN PAED 250 ML INF	41	11	39	70	83	48	82	14	56	06	66	6
22	AMINOPHILIN 24 MG INJEKSI	93	92	33	60	31	33	17	44	27	95	67	3
23	AMINOSTERIL INFANT 6%	13	69	22	42	17	74	85	14	64	22	26	9
24	AMITRIPTYLIN E TABLET	64	11	63	11	26	86	37	84	63	37	11	2
25	AMLODIPINE 5 MG TABLET	28	36	14	21	82	29	30	21	30	15	41	5
-	AMLODIPINE BESYLATE 10 MG TABLET	61	84	13	14	21	11	25	11	13	56	26	0
-	AMOXAN 500 MG KAPSUL	13	22	16	11	11	23	12	29	11	11	11	2

TABLE III. DATA SAMPLE YEAR 2016

No	Medicine	Month											
		1	2	3	4	5	6	7	8	9	10	11	12
1	ACILAZ 30 MG KAPSUL	18	20	16	23	27	92	22	19	15	41	10	1
2	ACYCLOVIR 400 MG TABLET	16	59	37	53	93	73	72	106	166	25	35	5
3	ACYCLOVIR 5% CREAM	11	12	62	89	18	14	11	11	18	17	84	8
4	ALBOTHYL GEL	14	44	32	17	20	79	86	19	49	48	8	8

5	ALBUMINAR 25% 100 ML INJEKSI	1	2	1	2	7	2	1	3	3	2	1	1	2
6	ALCO ORAL 15 ML DROPS	1	3	4	1	2	9	3	1	1	5	4	1	3
7	ALINAMIN F INJEKSI	2	2	1	1	2	2	1	4	3	-	-	-	-
8	ALINAMIN F TABLET	1	7	6	6	4	4	2	8	1	1	0	4	1
9	ALLUPURINOL 100 MG TABLET	2	1	9	1	9	5	8	1	4	1	9	1	1
10	ALLUPURINOL 300 MG TABLET	2	8	3	8	1	3	4	4	9	3	1	3	3
11	ALPRAZOLAM 0.5 MG TABLET	6	2	2	3	2	6	1	4	6	2	5	4	4
12	ALPRAZOLAM 1 MG TABLET	7	2	2	2	1	1	3	1	5	3	2	0	6
13	AMARYL 3 MG TABLET	2	2	2	5	1	2	6	5	1	4	3	3	3
14	AMARYL M 1/250 MG TABLET	2	1	4	3	1	6	4	1	0	7	8	0	0
15	AMARYL M 2/500 MG TABLET	5	1	8	1	3	1	2	2	6	1	1	1	1
16	AMBROXOL 60 ML SIRUP	4	5	1	1	3	3	1	4	1	1	5	1	1
17	AMINEFRON TABLET	1	6	9	1	1	2	9	2	5	1	8	4	3
18	AMINOFLUID 1000 ML INFUS	1	9	2	1	5	1	8	5	5	3	3	3	3
19	AMINOFLUID 500 MG INFUS	1	1	1	0	3	2	8	2	1	3	4	1	1
20	AMINOFUSIN HEPAR INFUS	1	2	5	2	9	5	2	8	1	0	7	7	7
21	AMINOFUSIN PAED 250 ML INF	1	8	5	8	6	2	1	1	5	9	5	3	2
22	AMINOPHILIN 24 MG INJEKSI	3	4	1	6	2	4	4	3	3	1	0	7	1
23	AMINOSTERIL INFANT 6%	3	9	6	2	1	1	4	1	4	4	0	1	1
24	AMITRIPTYLINE TABLET	2	4	1	8	5	7	3	1	0	2	5	5	9
25	AMLODIPINE 5 MG TABLET	3	1	0	9	3	1	1	0	0	3	1	3	3
..	AMLODIPINE BESYLATE 10 MG TABLET	1	0	7	1	2	5	9	5	3	8	1	1	8
..	AMOXAN 500 MG KAPSUL	3	1	4	9	3	1	2	3	2	1	3	1	1

At table 4 is result training data 80% from data total, with error 0.004, epoch 500, result training will make as testing for prediction needs drug with error 0.004, epoch 500 result testing show at table 4 for the prediction year 2016 and year 2017, result comparison ANFIS model and GA-ANFIS show at table 4 based evaluation RMSE model, which is GA produce influence significant to level accuracy ANFIS for prediction needs drug.

TABLE IV. COMPARATION ANFIS MODEL AND GA-ANFIS

Model	Training dataset		Testing dataset	
	2015	2016	2016	2017
ANFIS	0.4523	0.6450	0.5178	0.6598
GA-ANFIS	0.3218	0.4867	0.3412	0.4765

Based figure 3 generated level accuracy approach GA-ANFIS model produce level accuracy is better compared with ANFIS model at training dataset year 2015 and year 2016, testing process done based dataset training year 2015 for the testing year 2016, with RMSE value 0.5178 at ANFIS model, and GA-ANFIS produce RMSE 0.3412 at year 2016, while testing data year 2017 sourced from training the data year 2016, which GA-ANFIS model produced RMSE value of 0.4765 and ANFIS of 0.6598, so that GA application can influence level accuracy prediction ANFIS method.

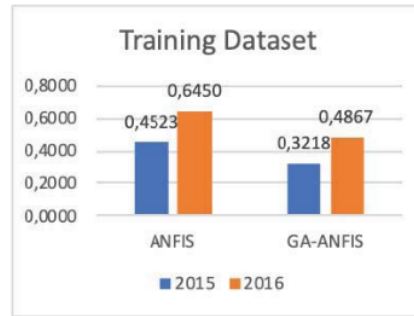


Fig. 3. Training Dataset

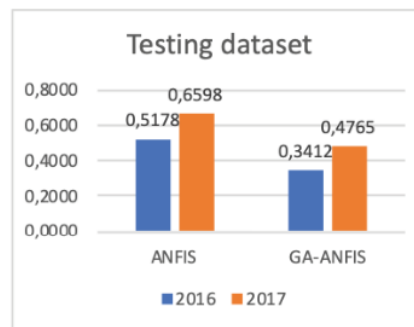


Fig. 4. Testing Dataset

V. CONCLUSION

The prediction needs of drugs optimal are one of important thing which is very influential medical services as well as finance in hospital area, in this research we propose GA approach to optimizing parameter training ANFIS until produce level accuracy, based on result testing GA approach produce significant influence towards result accuracy predict ANFIS on dataset usage drugs based on a note medical patient, where GA-ANFIS model has value RMSE of 0.6598 to predict usage drugs the year 2017, however this research still need do another approach like particle swarm optimization (PSO) approach on the literature show result is better than GA models.

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