Dietary Habits for Toddler Growth using Particles Swarm Optimization Algorithms

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***Abstract*—The age grouping of children used in the health program at the Indonesian Ministry of Health, the term baby (0 to less than one year), toddler (1 to 3 years), and preschool (3 to 5 years). Giving the wrong food to children can cause children to experience malnutrition. The danger of malnutrition in children for a long time can cause stunting. Stunting is a condition of growth failure in children (body and brain growth) due to a lack of nutrition for a long time. Thus, the child is shorter than normal children his age and has a delay in thinking. Malnourished children do not only have an impact on health complaints in the future. But it also makes children unable to grow optimally, thus interfering with their productivity when they grow up. Nutritional needs are an important factor during a child's growth period. In preparing a diet, you must pay attention to a balanced and varied menu, including the type of food in an appropriate amount. To meet the body's nutritional needs for the maintenance of cells in the body and the process of child development. Therefore, an application was created that can provide a combination of menus and dietary patterns for toddler and preschool age. This application uses the Particle Swarm Optimization algorithm in finding the best menu combination according to the child's age and physical condition. The results obtained in this study are dietary suggestions for toddlers and preschool age. The system test results have an accuracy of 90%.**

***Keywords*—Toddler, Preschoolers, Nutrition, Particle Swarm Optimization, Dietary patterns, Stunting.**

I. INTRODUCTION

The toddler is a term for children aged 1-3 years (toddlers) and preschoolers (3-5 years). Toddlers are known as passive consumers, meaning they accept the type of food given by parents. For this reason, parents must strictly control their food intake, starting from the type of food they like; it is easy to chew, easy to digest, and contains complete nutrition [1]. Food intake must also be appropriate and meet the nutrients needed by children to fulfill nutritional information that will affect children's growth and development [2]. In preparing food menus, parents must always stick to a balanced menu pattern. As a guide, children must consume vegetable protein, animal protein, fat, carbohydrates, vitamins, minerals, fiber, and enough water [1]. Eating patterns have a relationship with the growth and development of children where parents who have enough knowledge about balanced menus will monitor and train the child's optimal development to prevent developmental abnormalities in children that can be known early [3]. With the problem of choosing a balanced diet, information technology is needed to identify a balanced diet with a nutritional status that is by its dietary needs. An expert system method can be integrated using the Particle Swarm Optimization algorithm [2]. The algorithm is used to choose a balanced diet because the calculations are relatively simple, using the most optimal fitness values [4]. In this study, an expert system was made in the form of an android-based application using the Particle Swarm Optimization Algorithm to plan and select food menu patterns for toddlers. This system will help parents choose a diet with a balanced diet with nutritional needs by children's dietary needs [2].

II. RELATED WORK

Implementation of particle swarm optimization (PSO) algorithm for optimizing the fulfillment of toddlers' nutritional needs. In the completion of nutrients, one type of food alone is not enough, so it requires various food ingredients that contain all the elements of nutrients. The nutritional needs of Indonesian people have been set in the guidelines of Balanced Nutrition Guidelines by the Ministry of Health Republic Indonesia, including dietary guidelines to meet infants' nutritional needs [5].

Optimization of food composition for people with hypertension using the particle swarm optimization method. Indonesia ranks second largest in Southeast Asia in the number of deaths caused by hypertension. One Way to treatment Hypertension disease is to control weight and reduce the amount of salt consumed. To solve the problem using Particle Swarm Optimization (PSO) method. The representation of the particles used is the food index. The number of dimensions used is 14. The number of sizes indicates the number of features consisting of breakfast, complementary food, lunch, complementary meals and dinner [6].

Optimization of meeting the nutritional needs of families using particle swarm optimization. Data consumption of Indonesian society, when checked with balanced nutritional guidelines, tends still below standard. This is confirmed by Basic Health Research 2013 by Indonesian Health Ministry who found the data on fruit and vegetable consumption by people aged over ten years who are still under which it should be, namely 93.5% [7].

The toddler is a time when children start walking and is the most significant period in growth and development, namely at the age of 1 to 5 years. This period is a crucial period for the development of intelligence and intellectual growth. (Mitayani, 2010). The toddler is a general term for children aged 1-3 years (toddlers) and preschoolers (3-5 years). Children are still wholly dependent on parents to do essential activities at the age of toddlers, such as bathing, pooping, and eating. The development of speaking and walking has improved. But other abilities are still limited. (Sutomo, 2010). Parents have an important role in optimizing the development of a child. Parents must always provide stimulation or stimulation to children in all aspects of development, both gross and fine motor, language and social

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person. The stimulation must be given routinely and continuously with love and play methods. The child's development will run optimally, and lack of stimulation from parents can cause delays in children's development (Dinkes, 2009). For toddlers, nutritious food is fundamental because nutrition is one of the factors that influence the growth process. Nutritious food is food that contains substances needed by the body. For toddlers, nutritious food is fundamental because nutrition is one factor that influences the growth process. Children who are malnourished will show signs such as stunted body, shortsightedness, slow motor skills, poor schooling, or even ability [8].

III. RESEARCH METHOD

Every toddler needs nutrition and energy required for the body, to calculate the ideal body weight or Approximate Weight Per Age (WPA) can be seen in equation (1), to calculate energy needs can be seen in equation (2) and equation (3), to calculate protein needs can be seen in equation (4), to calculate fat requirements can be seen in equation (5), to calculate carbohydrate needs can be seen in equation (6).

$$\text{WPA} = (\text{Age x } 2) + 8 \quad (1)$$

$$\text{Energy needs} = 100 \frac{cal}{/Kg} \times WPA \text{ (for 1 to 3 years old)} \quad (2)$$

$$\text{Energy needs} = 90 \frac{cal}{/Kg} \times WPA \text{ (for 4 to 5 years old)} \quad (3)$$

$$\text{Protein Need} = \frac{10\% \times energy\ need}{4} \quad (4)$$

$$\text{Fat Need} = \frac{20\% \times energy\ need}{9} \quad (5)$$

$$\text{Carbohydrates Need} = \frac{70\% \times energy\ need}{4} \quad (6)$$

Stages -stages in the optimization process using Particle Swarm Optimization [9]:

1. Initialization of the Particle Swarm Optimization parameters, the number of particles, C1 and C2, the random value (rand), Wmin and Wmax, and the upper limit used.

TABLE I. PSO PARAMETER

Number of Particles	C1	C2	Rand1	Rand2	Itermax	Wmin	Wmax	Upper limit

Information:
Number of Particles = the number of particles in one iteration
$C1 = 1st\ acceleration\ coefficient\ value$
$C2 = 2nd\ acceleration\ coefficient\ value$
$Rand = random\ value\ [0,1]$
$Itermax = maximum\ number\ of\ iterations$
$Wmin = initial\ inertia\ value$
$Wmax = final\ inertia\ value$

2. It is generating the initial population as much as the population specified in the initialization process.
3. Each particle has a velocity, and the initial velocity of each particle is set to 0. Initialization of particles is generated randomly using Xmin and Xmax, where Xmin is obtained from the smallest index value for each type of foodstuff and Xmax is obtained from the largest index value for each foodstuff by using equation (7).

$$x = \text{Xmin} + \text{rand}\,(\text{Xmax} - \text{Xmin}) \quad (7)$$

Information:
Xmin = smallest index value of food ingredients
Xmax = the greatest value index of food ingredients
Rand = random value [0,1]

4. Calculate the value of particles for each particle.
5. The calculation of the fitness value used to match the issues raised in [10]:

$$\text{Fitness} = \left(\frac{1}{\text{Nutritional penalty}} \times 100000\right) + Variation \quad (8)$$

The variation value is 87 which is obtained from the total amount of each food ingredient and the nutritional equation used as follows [10]:

$$\text{Nutritional penalty} = |\text{Energy Needs} - \text{Calories}| + |\text{Carbohydrates Need} - \text{Carbohydrates}| + |\text{Fat Need} - \text{Fat}| + |\text{Protein Need} - \text{Protein}| \quad (9)$$

To find out the amount of content of each food ingredient used equation 3 as below [10]:

$$Index - i = \left((x-1) * \left(\frac{y-1}{z-1}\right)\right) + 1 \quad (10)$$

Information:
x = number of members of food items
y = dimension value i
z = permutation rate limit

6. Determine Pbest and Gbest.
7. In early iterations, Pbest value equated with the initial position of the particle and Gbest value obtained from Pbest's highest fitness value.
8. Update the Velocity value. Velocity calculation is the first step in Particle Swarm Optimization calculation in each iteration before doing Position calculation; velocity is a function of a particle's speed to determine where the next position will be calculated in a particle. To calculate the new speed, you can use equation (12), but before calculating the latest speed you need to know the value of W (inertia weight) that can be seen in equation (11) [10].

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$$W = \frac{Wmax-(Wmax-Wmin)}{iteremax} \times iteration \quad (11)$$

$$W^{*}V_j^K + C1^{*}rand1 \times \left(Pbest_j - X_j^K\right) + C2^{*}rand2 \times \left(Gbest_j - X_j^K\right) \quad (12)$$

Information:
V_j^K = velocity dimension j in iteration k
W = inertia weight
$C1$ = coefficient of acceleration to -1
$C2$ = 2nd acceleration coefficient value
$rand$ = random value $[0,1]$
X_j^K = Position of the J Dimension in the K iteration
$Pbest_j$ = Pbest value of the j dimension

9. Position update. Position calculation is a calculation to determine the position of food index positions in particles. To calculate and update new positions is to add velocity or velocity that has been calculated for each particle added to the current position or previous position, then the value of that position will be rounded. This new position will be the particle that will be compared to the fitness of the last particle fitness, and the best will be Pbest [11].

10. In calculating position updates using equation (13), the example of calculating position updates is as follows:

$$X_j^{k+1} = X_j^k + V_j^{k+1} \quad (13)$$

Information:
X_j^{k+1} = position of the J dimension in the K iteration
V_j^{k+1} = velocity dimension J in K iteration

11. Repeat steps 3-7 for the number of particles present. Iterates until the stop condition is reached with the best particle results from all iterations.
The terms used in applying the PSO algorithm are as follows [11] [12]:
    a. Swarm
    the population of particles.
    b. Particle
    the individual in a swarm. Each particle represents a solution to the problem being solved.
    c. Pbest
    a particle that shows the best position.
    d. Gbest
    the best position of all particles in a swarm.
    e. Velocity
    the speed each particle has in determining the direction of a particle's movement to improve its original position.
    f. C1 and C2
    C1 are learning constants cognitive and C2 are social learning constants.

IV. Particle Swarm Optimization Algorithm

A. Toddler Data

Toddler data obtained from the results of a questionnaire that had been made before, totaling 30 toddler data. The total number of foodstuffs was 87, namely 20 animal protein foods, 12 vegetable proteins, 11 carbohydrates, 10 fat, 19 vegetables, and 15 fruits [10] [12] [13].

B. Pso Parameters

TABLE II. PSO PARAMETER

Num of Particles	C1	C2	Rand1	Rand2	Itermax	Wmin	Wmax	Upper limit
2	2	2	0.9342	0.3963	20	0.4	0.7	50

TABLE III. TODDLER DATA

Name	Age	Weight	Height
Sasa	4.2	98 Cm	16.7 Kg

After inputting toddlers data and determining PSO parameters, then calculate the toddlers' nutritional needs using equation (14) [12].

$$WPA = (Y \times 2) + 8 \quad (14)$$
$$WPA = (4.2 \times 2) + 8 = 16.4\ Kg$$

Information:
WPA = Approximate Weight Per Age
Y = Age years

From the WPA results above, the nutritional intake needs were sought [12].

$$\text{Energy Needs} = 90 \times (16.4) = 1476$$

$$\text{Calories Need Protein} = \frac{10\% \times 1467}{4} = 36.9\ gram$$

$$\text{Need Fat} = \frac{20\% \times 1467}{9} = 32.8\ gram$$

$$\text{Need Carbohydrates} = \frac{70\% \times 1467}{4} = 258.3\ gram$$

C. Initial Particle and velocity initialization

TABLE IV. INITIAL PARTICLE

	M	AP	VP	C	F	V	Fr	Ap	VP	C	F	V
X1	1	5	10	1	8	11	4	20	9	4	5	18
X2	1	2	10	7	4	3	2	4	3	2	3	13

	M	AP	VP	C	F	V	Fr	M
X1	1	1	3	10	9	17	5	1
X2	1	9	7	7	5	15	12	1

Information:
$M = Milk$
$AP = Animal\ Protein$

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$VP = Vegetable\ Protein$
$C = Carbohydrates$
$F = Fat$
$V = Vegetable$
$Fr = Fruit$

D. Calculate The Value Of Fitness

$X1$:

1. $Calories$
$= 513 + 50 + 328 + 180 + 902 + 22 + 50 + 75 + 328 + 149 + 902 + 50 + 513 + 50 + 80 + 120 + 902 + 50 + 50 + 513$
$= 5827\ calories$

2. $Protein = 7 + 12.6 + 7 + 12.6 + 7 + 6 = 52.2\ gram$
3. $Fat = 100 + 100 + 100 = 300\ gram$
4. $Carbohydrates = 40 + 32.5 + 26 = 98.5\ gram$

$X2$:

1. $Calories$
$= 513 + 50 + 328 + 149 + 902 + 50 + 50 + 50 + 80 + 175 + 372 + 22 + 513 + 150 + 80 + 175 + 902 + 50 + 40 + 513$
$= 5164\ calories$
2. $Protein = 7 + 7 + 7 + 12.6 + 6 + 6 = 45.6\ gram$
3. $Fat = 100 + 29.4 + 100 = 229.4\ gram$
4. $Carbohydrates = 40 + 32.5 + 32.5 = 105\ gram$

After obtaining the total content of each dimension from food ingredients, the nutritional and fitness value of each particle can be calculated as follows.

$X1$:
$Nutritional\ penalty$
$= |1476 - 5827| + |36.9 - 52.2| + |32.8 - 300| + |258.3 - 98.5|$
$= 4793.3$

Fitness
$= \left(\frac{1}{4793.3} \times 100000\right) + 87 = 107.86$

$X2$:
$Nutritional\ penalty$
$= |1476 - 5164| + |36.9 - 45.6| + |32.8 - 229.4| + |258.3 - 105|$
$= 4046.6$

Fitness
$= \left(\frac{1}{4046.6} \times 100000\right) + 87 = 111.71$

E. Pbest and Gbest initialization

TABLE V. PBEST INITIALIZATION

	M	AP	VP	C	F	V	Fr	Ap	VP	C	F	V
Pbest1	1	5	10	1	8	11	4	20	9	4	5	18
Pbest2	1	2	10	7	4	3	2	4	3	2	3	13

	M	AP	VP	C	F	V	Fr	M	Fitness
Pbest1	1	1	3	10	9	17	5	1	**107.86**
Pbest2	1	9	7	7	5	15	12	1	**111.71**

TABLE VI. GBEST INITIALIZATION

	M	AP	VP	C	F	V	Fr	Ap	VP	C	F	V
Gbest1	1	2	10	7	4	3	2	4	3	2	3	13

	M	AP	VP	C	F	V	Fr	M	Fitness
Gbest1	1	9	7	7	5	15	12	1	**111.71**

F. Velocity Update

TABLE VII. CALCULATION RESULTS FOR VELOCITY UPDATES

Iteration = 1										
V1	0	-2.37	0	4.75	-3.16	-6.33	-1.58	-12.67	-4.75	-1.58
V2	0	0	0	0	0	0	0	0	0	0

Iteration = 1										
V1	-1.58	-3.96	0	6.33	3.16	-2.37	-3.16	-1.58	5.54	0
V2	0	0	0	0	0	0	0	0	0	0

G. Update Position And Calculate Fitness

TABLE VIII. POSITION UPDATE CALCULATION RESULTS

Iteration = 1										
X1	1	2.63	10	5.75	4.84	4.67	2.42	7.33	4.25	2.42
X2	1	2	10	7	4	3	2	4	3	2

Iteration = 1										
X1	3.42	11.04	1	7.33	6.16	7.63	5.84	15.42	10.54	1
X2	3	13	1	9	7	7	5	15	12	1

If the nutritional penalty for particles X1 and X2 is 3930.5 and 4046.6, then:

Fitness (X1) $= \left(\frac{1}{3930.5} \times 100000\right) + 87 = 112.44$

Fitness (X2) $= \left(\frac{1}{4046.6} \times 100000\right) + 87 = 111.71$

H. Pbest And Gbest Updates

TABLE IX. PBEST UPDATE RESULTS

	M	AP	VP	C	F	V	Fr	Ap	VP	C	F	V
Pbest1	1	3	10	6	5	5	2	7	4	2	3	11
Pbest2	1	2	10	7	4	3	2	4	3	2	3	11

	M	AP	VP	C	F	V	Fr	M	Fitness
Pbest1	1	7	6	8	6	15	11	1	**112.44**
Pbest2	1	9	7	7	5	15	12	1	**111.71**

TABLE X. GBEST UPDATE RESULT

	M	AP	VP	C	F	V	Fr	Ap	VP	C	F	V
Gbest1	1	3	10	6	5	5	2	7	4	2	3	11

	M	AP	VP	C	F	V	Fr	M	Fitness
Gbest1	1	7	6	8	6	15	11	1	**112.44**

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I. Optimization Results

TABLE XI. OPTIMIZATION RESULT

Eating Time	Food Name	Total Weight Req. (g)
Breakfast	Milk	0
	Mackerel	30
	Egg Tofu	100
	Brown Rice	100
	Margarine	15
	Red Spinach	100
	Watermelon	180
Lunch	Dried Anchovies	20
	Tofu	100
	Rice	100
	Coconut Oil	5
	Cabbage Leaves	100
	Milk	0
Dinner	Dried Anchovies	20
	Tofu	100
	Brown Rice	100
	Margarine	15
	Pepaya Leaf	100
	Pineapple	85
	Milk	0

By testing as many as 30 samples (people) and consulting with a doctor based on the test results can be seen in Table 12 for examples of test results.

TABLE XII. TODDLERS DATA RESULTS

No	Name	Gender	Age	Height	Weight	Result
1	Kid 1	Girl	4	127	16	Agree
2	Kid 2	Girl	3	100	10	Agree
3	Kid 3	Girl	3.5	120	14	Agree
4	Kid 4	Girl	3.5	100	14	Agree
5	Kid 5	Boy	2	100	11	Agree
6	Kid 6	Girl	3	85	11	Agree
7	Kid 7	Girl	3	100	11	Agree
8	Kid 8	Boy	2.5	85	13	Agree
9	Kid 9	Girl	3	100	12	Not Agree
10	Kid 10	Boy	2	115	13	Not Agree
11	Kid 11	Girl	4	130	15	Agree
12	Kid 12	Boy	3	108	13.8	Agree
13	Kid 13	Girl	2	90	11	Agree
14	Kid 14	Boy	3.5	109	17	Agree
15	Kid 15	Boy	2.5	100	14	Agree
16	Kid 16	Girl	3	101	13	Agree
17	Kid 17	Girl	4	104	12	Agree
18	Kid 18	Boy	1.5	87	12	Agree
19	Kid 19	Girl	2	95	11	Agree
20	Kid 20	Girl	4.5	115	20	Agree
21	Kid 21	Boy	4.5	105	15	Not Agree
22	Kid 22	Boy	4	100	14	Agree
23	Kid 23	Boy	3	100	12	Agree
24	Kid 24	Girl	2	90	10	Agree
25	Kid 25	Girl	3	95	10	Agree
26	Kid 26	Girl	3	100	12	Agree
27	Kid 27	Boy	3	100	11	Agree
28	Kid 28	Boy	4.5	110	14	Agree
29	Kid 29	Boy	4	110	13	Agree
30	Kid 30	Girl	3.5	100	13	Agree

TABLE XIII. SAMPLE TEST RESULTS

No	Name	Gender	Age (year)	Height	Weight	Toddler Needs
1	Kid 2	Girl	3	100	10	WPA: 14 Kg Energy: 1400 cal Protein: 35g Fat: 31.1 g Carbo: 245g
2	Kid 1	Girl	4	127	16	WPA: 16 Kg Energy: 1440 cal Protein: 36g Fat: 32 g Carbo: 252g

TABLE XIV. SAMPLE MEAL MENU SCHEDULE

Eating Time	Food Name	Total Amount of Weight Needed (gram)
Breakfast	Chicken's liver	30
	Egg Tofu	100
	Rice Team	100
	Margarine	15
	Spinach	100
	Ambon Banana	50
Lunch	Mackerel	30
	Tofu	100
	Brown Rice	100
	Avocado	60
	Eggplant	100
Dinner	Eel	45
	Tofu	100
	Brown Rice	100
	Margarine	15
	Red Spinach	100
	Papaya	100

From these test results, the accuracy of the results obtained as follows [14] [15] [16].

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$$Accuracy = \frac{number\ of\ predictions\ correct}{total\ number\ of\ prediction} \times 100\% \quad (15)$$

$$Accuracy = \frac{27}{30} \times\ 100\% = 90\%$$

The results obtained are 90% accuracy, according to which doctors in the optimization results obtained there are still some weight of food that is less appropriate to the nutritional needs of the toddler and less varied menus.

V. CONCLUSIONS

1. The parameters of the Particle Swarm Optimization algorithm used in this research get the optimal optimization results are the number of particles = 20, wmin = 0.4, wmax = 0.7, C1 = C2 = 2, the number of iterations = 20, and the upper limit of the permutation number is 50.
2. The accuracy of the testing data obtained results of 90%.

REFERENCES

[1] B. Sutomo S.Pd and D. D. Yanti Angrraini, Menu Sehat Alamai untuk Batita & Balita, Jakarta: Demedia, 2010.

[2] P. B. Santoso, E. L. Amalia and H. S. Dachlan, "Integrasi Sistem Pakar Dan Algoritma Genetika Untuk Mengidentifikasi Status Gizi Pada Balita," Jurnal EECCIS, vol. 8, no. 1, pp. 1–6, 2014.

[3] Husnah, "Hubungan Pola Makan, Pertumbuhan dan Stimulasi dengan Perkembangan Anak Usia Balita di Posyandu Melati Kuta Alam Banda Aceh," J. Kedokt. Syiah Kuala, vol. 15, no. 2, pp. 66–71, 2015.

[4] M. Juneja and S. K. Nagar, "Particle swarm optimization algorithm and its parameters: A review," 2016 International Conference on Control, Computing, Communication and Materials (ICCCCM), Allahbad, 2016, pp. 1-5, doi: 10.1109/ICCCCM.2016.7918233.

[5] L. Istikomah and I. Cholissodin, "Implementasi Algoritma Particle Swarm Optimization (PSO) untuk Optimasi Pemenuhan Kebutuhan Gizi Balita," Jurnal Pengembangan Teknologi Informasi dan Ilmu Komputer, vol. 1, no. 11, pp. 1321-1330, 2017.

[6] A. A. Boestari, D. E. Ratnawati and T. S. Kusuma, "Optimasi Komposisi Makanan Bagi Penderita Hipertensi Menggunakan Metode Particle Swarm Optimization," J. Pengemb. Teknol. Inf. dan Ilmu Komputer. Univ. Brawijaya, vol. 1, no. 10, pp. 1158–1167, 2017.

[7] I. F. Eliantara and I. Cholissodin, "Optimasi Pemenuhan Kebutuhan Gizi Keluarga Menggunakan Particle Swarm Optimization," Prosiding SNRT (Seminar Nasional Riset Terapan), vol. 5662, pp. 9–10, 2016.

[8] R. N. E. Anggraini, S. Rochimah and K. D. Dalmi, "Mobile nutrition recommendation system for 0–2 year infant," 2014 The 1st International Conference on Information Technology, Computer, and Electrical Engineering, Semarang, 2014, pp. 272-275, doi: 10.1109/ICITACEE.2014.7065755.

[9] Z. Y. Rachmat, D. E. Ratnawati and A. Arwan, "Optimasi Komposisi Makanan Untuk Atlet Endurance," Jurnal Teknologi Informasi dan Ilmu Komputer, vol. 3, no. 2, pp. 103–109, 2016.

[10] I. Cholissodin and R. K. Dewi, "Optimization of Healthy Diet Menu Variation using PSO-SA," J. Inf. Technol. Comput. Sci., vol. 2, no. 1, pp. 28–40, 2017.

[11] M. Mansur, T. Prahasto and F. Farikhin, "Particle Swarm Optimization untuk Sistem Informasi penjadwalan Resource Di Perguruan Tinggi,"Jurnal Sistem Informasi Bisnis, vol.4, no. 1, pp. 11-19, 2014.

[12] M. Varman and M. Niccolai, "Expert system in neonatal total parenteral nutrition," Proceedings of the 1997 16 Southern Biomedical Engineering Conference, Biloxi, MS, USA, 1997, pp. 50-53, doi: 10.1109/SBEC.1997.583212.

[13] Kementerian Kesehatan RI, "Pedoman PGS Kesehatan," pp. 1–99, 2014.

[14] A. S. Khalid Waleed, P. D. Kusuma and C. Setianingsih, "Monitoring and Classification System of River Water Pollution Conditions with Fuzzy Logic," 2019 IEEE International Conference on Industry 4.0, Artificial Intelligence, and Communications Technology (IAICT), BALI, Indonesia, 2019, pp. 112-117, doi: 10.1109/ICIAICT.2019.8784857.

[15] S. Darmawan, B. Irawan, C. Setianingsih and M. A. Murty, "Design of Detection Device for Sea Water Waves with Fuzzy Algorithm Based on Internet of Things," 2020 IEEE International Conference on Industry 4.0, Artificial Intelligence, and Communications Technology (IAICT), Bali, Indonesia, 2020, pp. 75-80, doi: 10.1109/IAICT50021.2020.9172018.

[16] A. T. Hutomo, M. Nasrun and C. Setianingsih, "Web-Based Psychological Rothwell Miller Interest Blank (RMIB) Test using Fuzzy Method," 2020 IEEE International Conference on Industry 4.0, Artificial Intelligence, and Communications Technology (IAICT), Bali, Indonesia, 2020, pp. 107-112, doi: 10.1109/IAICT50021.2020.9172036.

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