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Optimizing the Diet of Diabetes Mellitus Sufferers Through Food Mapping Using the Fuzzy Sugeno Method

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ABSTRACT Article Info Article history: This research focuses on developing optimal strategies for diet management for Diabetes Mellitus (DM) sufferers by utilizing the Fuzzy Received Nov 20, 2023 Sugeno method in food mapping. Diabetes Mellitus is a chronic Revised Nov 24, 2023 metabolic disease that requires a careful management approach to diet Accepted Nov 30, 2023 to control blood sugar levels. In this study, we designed a system that uses Sugeno's fuzzy principles to categorize foods based on glycemic parameters, nutritional content, and individual patient characteristics. Keywords: This method allows the formation of fuzzy rules that cover the variability and complexity in the preferences and health needs of each patient. The **Diabetes** mellitus developed model was tested using DM patient data involving detailed Diet information about diet, medical history and blood sugar response. Fuzzy Sugeno Experimental results show that this approach can provide more Food Mapping personalized diet recommendations that suit individual health Blood Sugar Management

personalized diet recommendations that suit individual health conditions. The application of the Fuzzy Sugeno method in food mapping for DM patients is expected to increase patient compliance with the recommended diet, reduce blood sugar levels, and overall, improve quality of life. Additionally, this approach also provides a foundation for the development of adaptive dietary management systems, which can continuously adapt to changing patient health needs over time.

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1. INTRODUCTION

Diabetes Mellitus (DM) is one of the main challenges in the global health sector, with a significant increase in prevalence in various countries. DM management requires a holistic approach, especially in managing the patient's diet to maintain blood sugar levels within normal limits. A proper diet plays an important role in controlling symptoms and preventing long-term complications that can occur in DM sufferers [1], [2], [3]. In using the Tsukamoto fuzzy method, the first thing to do is determine the membership function, then determine the rules and later the categories will be clustered into each group according to the rules applied [4], [5], [6].

Choosing foods that suit individual health needs is often a complex and confusing task for DM sufferers. Different health conditions, food preferences, and unique body responses demand a personalized and adaptive approach in designing dietary recommendations. Therefore, it is necessary to develop a system that is able to provide more specific dietary recommendations and according to the characteristics of each patient [7], [8], [9].

The Fuzzy Sugeno method, as an artificial intelligence technique, offers an approach that can handle uncertainty and complexity in decision making. By embracing fuzzy principles, these systems can map uncertain or ambiguous information, such as patient preferences and food characteristics, into categories that can be used to construct more accurate dietary recommendations [10], [11].

With this background, this research aims to optimize the diet management of DM sufferers through the application of the Fuzzy Sugeno method in food mapping. It is hoped that this research can make a positive contribution in improving the quality of life of DM sufferers, reducing the risk of complications, and leading to the development of a more adaptive and personalized diet management system [6], [12][13].

2. RESEARCH METHOD

To assist this research, a research phase framework is needed. The stages of this research are the steps that will be tried in solving the problems discussed. There are also stages of research used are as follows [25], [3], [14].



Figure 1. Research Framework

Based on the research stages above, the discussion of each stage in the research can be described as follows [23], [24] [15]:

1. Study Literature

At this stage, a search is carried out for theoretical foundations obtained from various books and also the internet to complete the vocabulary of concepts and theories, so that they have a good and appropriate scientific foundation.

2. Data Collection

The data collection methods used in this research are:

a. Problem analysis

Data collection in conducting research uses a questionnaire method, and the variables are the symptoms experienced by patients suffering from diabetes mellitus.

b. Literature review

Collecting data by using or collecting written sources, by reading, studying and recording important things sourced from books, journals and the internet which are related to the problem being discussed in order to obtain a theoretical picture.

3. Designing the System

At this stage, the system is designed using UML (Unified Modeling Language) modeling and at this stage the application interface to be created is designed.

4. System Testing

At this stage the previously designed application has been completed and the application testing stage is carried out to see if there are any errors or damage to the application that has been designed.

2.1 Fuzzy Method Calculation

This research uses a fuzzy method to determine the percentage of diabetes mellitus suffered. The following is a description of the rules for the food mapping application for patients with diabetes mellitus [16]:

Code	Symptom	Category	Weight
Goi	Frequent urination, especially at night.	Light	0.3
Go2	Often thirsty.	Light	0.2
Goz	Often feel hungry.	Light	0.2
Go4	Sudden weight loss.	Heavy	0.8
Go5	Blurred vision.	Heavy	0.7
Go6	Easily attacked by infectious diseases.	Currently	0.5
Go7	Wounds that are difficult to heal.	Currently	0.4
Go8	Feeling stiff or tingling in the legs.	Currently	0.6
Go9	Constant fatigue	Light	0.3
G10	Feeling very tired.	Heavy	0.8
G11	Itching around the genitals.	Light	0.3
G12	Recurring thrush.	S Currently	0.6
G13	Pain or numbness in the feet and hands.	Heavy	0.9

Table 1. Symptoms

1. Computing the Fuzzification Process

- a. Light Category With Intervals $0, 0 \le a \le 0, 4$ b = 0, 0 + 0, 1 + 0, 2 + 0, 3 + 0, 4 = 1 = 0.2
- b. Medium Category With Interval $0,3 \le a \le 0,7$ b = 0,3 + 0,4 + 0,5 + 0,6 + 0,7 = 2.5 = 0.5
- c. Weight Categories With Intervals $0, 6 \le a \le 1$ $b = \underline{0, 6 + 0, 7 + 0, 8 + 0, 9 + 1} = \underline{4} = 0.8$ 5
 5
 5

2. Calculating Defuzzification Values

Go2= Often thirsty

Go₃= Often feel hungry

Go7= Wounds that are difficult to heal

- a. Count F (Go2) F = 0.2 - 0.0 = 10.2 - 0.0
- b. Count F (Go₃) F = 0.2 - 0.0 = 10.2 - 0.0
- c. Count F (Go₇)

3. Computing the Defuzzification Process

- $= (FGo_2 * BNGo_2) + (FGo_3 * BNGo_3) + (FGo_7 * BNGo_7))$
- = ((1 * 0,2) + (1 * 0,2) + (0,5 * 0,4)) / 1+1+0,5

$$= 0,6 / 2,5 = 0,24$$

Disease severity = $0.24 \times 100\% = 24\%$. So based on these calculations, the fuzzy value of the input symptoms that lead to diabetes mellitus is 24%.

2.2 System Design Using UML (Unified Modeling Language)

This research uses a UML design consisting of Use Case Diagrams, Activity Diagrams, Squency Case Diagran, Activity Diagram, Squency Diagram dan Class Diagram [17],[18], [19].

1. Use case diagram

To get information from a system being created, the author uses a use case diagram, as in the picture below:



Figure 2. Use Case Diagram

- 2. Activity Diagram
 - a. Activity Information Diagram



Figure 3. Activity Information Diagram

b. Activity Diagram Detection



Figure 4. Activity Diagram Detection

c. Activity Diagram Food Data



Figure 5. Activity Diagram food Data

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3. Squency Diagram

The following is a sequence diagram for food mapping applications in patients with diabetes mellitus:





3. RESULTS AND DISCUSSIONS

In this section, it is explained the results of research and at the same time is given the comprehensive discussion. Results can be presented in figures, graphs, tables and others that make the reader understand easily. The discussion can be made in several sub-chapters [20],[21], [22].

3.1. Detection Application Display

The detection display is a menu that contains symptoms that lead to diabetes mellitus. The function of this display is to provide information about whether you have diabetes mellitus or not. The display can be seen in the image below.

Pemetaan Makanan	
MENU	Deteksi
Informasi	
Ø Deteksi	Pilih gejala yang sedang di alami.
⊞ Data Makanan	G01 - Sering buang air kecil, terutama pada malam hari. G02 - Sering haus. G03 - Sering merasa lapar. G04 - Penurunan berat badan secara tiba-tiba. G05 - Pandangan kabur. G06 - Mudah diserang penyakit infeksi. G07 - Luka yang sulit sembuh. G08 - Merasa kaku atau kesemutan pada kaki. G09 - Kelelahan terus-menerus. G10 - Merasa sangat lelah. G11 - Gatal di sekitar kelamin. G12 - Sariawan berulang kali. G13 - Nyeri atau mati rasa pada kaki dan tangan.

Figure 7. Detection Display

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3.2. Feeding Data Display

The food data display is a menu that contains data on foods that are good for consumption by diabetics. Users can add their own food to this system by clicking add food. The display can be seen in the image below.

← → C () k	ocalhost/makananfuzzy/datamakanan.php		Q & 🖈 🛛	0
Pemetaan Makanan	=			
	Data Makanan			
	+ Tambah Makanan			
	Show 10 v entries	Search:		
	Nama	Kalori	action	
	Nasi Putih	175 Kalori	edit	
	Talas Rebus	98 Kalori	edit	
	Ubi Rebus	125 Kalori	edit	
	Kentang Rebus	166 Kalori	edit	
	Daging Panggang	150 Kalori	edit	
	Ikan Mas Pepes	143 Kalori	edit	
	Telur Ayam Rebus	97 Kalori	edit	
	Ayam Panggang	164 Kalori	edit	
	Sop Sapi	227 Kalori	edit	

Figure 8. Food Data Display

3.3. Food Mapping Application Testing

Testing the food mapping application on patients suffering from diabetes mellitus is used to test the system in one of the menus where the data used is the process of detecting disease.

a. Detection Menu Display: the user will be shown a new display, namely the detection display. In this menu, users only need to select the symptom they are experiencing by clicking on the symptom.

Pemetaan Makanan		^
MENU	Deteksi	L
Informasi		L
Ø Deteksi	Pilih gejala yang sedang di alami.	L
🖽 Data Makanan	🗌 G01 - Sering buang air kecil, terutama pada malam hari.	L
	🗹 G02 - Sering haus.	L.
	🗹 G03 - Sering merasa lapar.	L.
	G04 - Penurunan berat badan secara tiba-tiba.	L.
	🗌 G05 - Pandangan kabur.	
	G06 - Mudah diserang penyakit infeksi.	I.
	🕑 G07 - Luka yang sulit sembuh.	
	🗌 G08 - Merasa kaku atau kesemutan pada kaki.	
	G09 - Kelelahan terus-menerus.	
	G10 - Merasa sangat lelah.	
	G11 - Gatal di sekitar kelamin.	
	G12 - Sariawan berulang kali.	
	G13 - Nyeri atau mati rasa pada kaki dan tangan.	

Figure 9. Deteksi

b. After completing the selection of symptoms experienced, the user will fill in the data display for gender, age, height (cm), weight (kg) and activities carried out with the aim of knowing the user's total calorie needs per day.

Pemetaan Makanan	=							
	G09 - Kelelahan terus-menerus.							
	G10 - Merasa sangat lelah.							
Intormasi	G11 - Gatal di sekitar kelamin.							
	G12 - Sariawan berulang kali.							
	G13 - Nyeri atau mati rasa pada kaki dan tangan.							
	Isi data terlebih dahulu Untuk Mengetahui Kebutuhan Kalori Anda							
	jenis kelamin :							
	laki-laki							
	usia :							
	40-59							
	tinggi badan :							
	180							
	harat haran -							
	80							
	aktivitäs yang oliakukan : menohara							
	Included							
	Deteksi							

Figure 10. Deteksi (Advanced)

c. Then click detection and a new display will appear, namely the detection results display. In this display, the results of the detection of diabetes mellitus will appear in the form of percentage, the patient's ideal body weight, the total number of calories the patient needs and the patient's type of food.

Nasi Pilih gejala yang secti 001 - Sering buang air kechi 003 - Sering buang air kechi 003 - Sering maraa lapati 004 - Penunanan berak badan 005 - Pendangan kaburi 006 - Pendangan kaburi 006 - Pendangan kaburi 007 - Sering maraa lapati 008 - Penunanan berak badan 009 - Sering maraa lapati 009 - Sering maraa lapati 009 - Penunanan berak badan 000 - Maraa kata kata kata 001 - Maraa kata kata kata 002 - Sering maraa lapati 003 - Sering Maburi 004 - Penunanan beraka kata kata 005 - Maraa kata kata kata 006 - Marada kata kata kata 007 - Kata ang sata kata kata 008 - Maraa kata kata kata 009 - Kata kata kata kata 010 - Maraa kata kata kata 011 - Gatad di satata heatani 012 - Sering maraa 013 - Nyeri atau mati mara sata 103 - Nyeri atau mati mara sata 104 - Apata	etaan Makanan	=				_	
Detecksi Berdsardan Berkhungan Krebot dispatan Nilai Fuzzy Dari Masukan Gejat Yang Mengarah ke Penyakit Pilih gejala yang setai Berdsardan Berkhungan dari Masukan Data Kebutuhan Kalori : Earzi Badan (del Yang Anda Butuhani 1260 001 - Sering buarg air keti 002 - Sering hara Berdsardan Berkhungan dari Masukan Data Kebutuhan Kalori : Earzi Badan (del Yang Anda Butuhani 1260 003 - Sering maraa lapar: Ohi Nama 004 - Sering maraa lapar: Nama humlan Kalori Perponi yang Dapat Anda Sesualian Dengan Kebutuhan Kalori 120 - Maraa ang sulf semtuh 005 - Brindangan kabu: Nama humlan Kalori Perponi yang Dapat Anda Sesualian Dengan Kebutuhan Kalori 120 - Maraa ang sulf semtuh 006 - Muraa hutuan terus menere 007 - Ukra yang sulf semtuh Nama Pengang 010 - Maraa akaka taku tere 100 - Maraa akaka taku tere 100 - Maraa akaka taku tere 101 - Maraa sang telak. 011 - Casal di suktori kabutari 121 - Sakayan beukang takit. 012 - Sakayan beukang takit. 013 - Nyeri atau matra sang 144 - Tumi Buncis 153 - Alori - 122 - Sakayan beukang takit. 163 - Nyeri atau matra sang 164 - Alori - 124 - Sakayan Sing Alori - 125 - Sakayan Beukang takit. 163 - Nyeri atau matra sang 164 - Alori - 124 - Pang Baja 164 - Alori - 124 - Pang Baja <td></td> <td></td> <td>Hasil</td> <td></td> <td></td> <td>×</td>			Hasil			×	
Pilin gejala yang sedar Berdsarkan Perhitungan dari Maukan Data Kabukuhan Kalori: Berdsarkan Perhitungan dari Maukan Despin Jago Data Marasa Kabukuhan Kalori Perporti yang Dapat Anda Sesualkan Dengan Kabutuhan Kalori Anda: 003 - Sering merasa lapar: N Nama Jumlah 004 - Penuruman berata baden Codo - Andraga kabuci N Nama Jumlah 005 - Mudah daseng penya Codo - Luka yang suit sentuh Bergang Penggang 105 Kalori Balari Barg Penggang 105 Kalori 006 - Murasa Saku kata basee Codo - Kaledaran terus-meren Codo - Kaledaran terus-meren Codo - Kaledaran terus-meren Codo - Kaledaran terus-meren Codo - Sariwan berulang talah Daging Panggang 105 Kalori 101 - Berga Bargang 102 Kalori 103 Sayar Azam Bi Kalori 103 - Nyeri alau meti rasa penjati Barga Panggang 104 Kalori 12 Bergi Bargan 13 Kalori 103 - Nyeri alau meti rasa penjati Barga Agaja 12 Kalori 13 Kalori 104 begutat 15 Kalori 14 Tumis Buncis 12 Kalori 105 Alperi Pang Agaja 12 Kalori		Deteksi	Berdasar Diabetes	lerdasarkan Perhitungan Tersebut didapatkan Nilai Fuzzy Dari Masukan Gejala Yang Mengarah ke Penyakit Jiabetes Melitus adalah 24%			
001 - Sering buarg air ketali Jumán Kedori Jana Akada menni - Azabal 12:do Kalon. 002 - Sering huas Beriko Dtak Makanan dan Jumlah Kalon (Perponi yang Dapat Anda Sexualtan Dengan Kebutuhan Kalon (Sexualtan Dengan Sexualtan Dengan Kebutuhan Kalon (Sexualtan Dengan Kebutuhan Kalon (Sexualtan Dengan Sexualtan		Pilih gejala yang sedar	Berdasar Berat Ba	Berdasahan Perhitungan dari Masukan Data Kebutuhan Kalori : Berat Badan Ideal Yang Anda Butuhkan 1724. Juniah kebutuhan Juaniah Tada Anga Perhari Adalah 12268 kalori. Berikut Data Makanan dan Jumlah Kalori Perporsi yang Dapat Anda Sesuakan Dengan Kebutuhan Kalori Anda :			
No. Name Numlah. 0.03 - Sening merasa lapar Nesh Puhh 175 Kalori 0.04 - Reunigns hasta 2. Task Rehus 0.4 Selari 0.05 - Pondangan kabur. 1.016 Rehus 0.4 Selari 0.5 Kalori 0.05 - Pondangan kabur. 1.016 Rehus 0.4 Selari 0.5 Kalori 0.05 - Mudah diserang penya 1.02 Kalori 0.6 Kalori 0.6 Kalori 0.07 - Luka yang sulit sembuh 0. Bang Rengang 1.94 Kalori 0.6 Kalori 0.09 - Merasa kabu atas katura taska 8. Ayam Penggang 1.44 Kalori 0.09 - Merasa kabu atase kabu 1.05 Segs Sagi 2.27 Kalori 0.24 Kalori 0.09 - Merasa kabu atase fatakatani 1.05 Segs Sagi 2.27 Kalori 0.24 Kalori 0.01 - Merasa kabu atase fatakatani 1.05 Segs Agi 2.27 Kalori 0.24 Kalori 0.11 - Casal di selatifa Kalori 1.05 Segs Agi 2.27 Kalori 0.24 Kalori 1.01 - Casal di selatifa Kalori 1.05 Segs Agi 2.27 Kalori 0.24 Kalori 1.02 - Seriayam berulang tatali 1.65 Segs Agi 2.27 Kalori 0.24 Kalori <tr< td=""><td></td><td> G01 - Sering buang air kecil, t G02 - Sering haus. </td><td>Berikut (Anda :</td></tr<>		 G01 - Sering buang air kecil, t G02 - Sering haus. 	Berikut (Anda :				
0.684 - Penurunan barat badar 1. Nai Puth 17 Salori 0.695 - Penurunan barat badar 2. Uiti Balas Rebusi 28 Salori 0.695 - Penudangan kabur. 3. Uiti Bebusi 12 Salori 0.696 - Mudangan kabur. 3. Uiti Bebusi 12 Salori 0.696 - Mudangan kabur. 3. Daging Panggang 19 Salori 0.697 - Luka yang salik anteu kere 3. Daging Panggang 19 Salori 0.697 - Luka yang salik anteu kere 7. Tahur Ayam Rebusi 19 Salori 0.699 - Merasia sangat leiah. 10. Sayar Asam 68 Kalori 0.699 - Merasia sangat leiah. 10. Sayar Asam 68 Kalori 0.510 - Merasia sangat leiah. 10. Sayar Asam 68 Kalori 0.511 - Gatal di sektar katamini 10. Sayar Asam 68 Kalori 1.2 Bengi Bayam 13 Kalori 12 Kalori 1.3 Sayar Cadeh 14 Kalori 14 Kalori 1.4 Tumis Dunch Singkong 13 Kalori 15 Kalori 1.5 Astalori 14 Kalori		G03 - Sering merasa lapar.	No	Nama		Jumlah	
000 - Pendagang Nabur. 2. Tala Rebus 98 Adori 000 - Pendagang Nabur. 1.0 Lik Rebus 125 Kalori 000 - Mudah diserang penya 1.4 Kentang Rebus 166 Kalori 000 - Mudah diserang penya 1.5 Kalori 150 Kalori 000 - Muras ang sult semthu 6. Lan Kas Pepes 143 Kalori 000 - Muras ang sult semthu 6. Lan Mas Pepes 143 Kalori 000 - Muras ang sult semthu 6. Lan Mas Pepes 143 Kalori 000 - Muras ang sult semthu 6. Sep Sapi 227 Kalori 010 - Muras ang sult laku 10. Sep Xapi 227 Kalori 011 - Gata di racket Matomiti 10. Seg Xapi 227 Kalori 013 - Maras ang sult laku 10. Seg Xapi 22 Kalori 12 - Sariwan beulang tala 1.4 Curdi Buncis 24 Kalori 13 Kalori 013 - Nyeri atau mali rasa pati 14. Tumis Buncis 24 Kalori 14 data tertechi dalvid Untukti 10. Alguit 15 Kalori 15 data tertechi dalvid Untukti 10. Alguit 12 Kalori		G04 Province baset bades	1.	Nasi Putih		175 Kalori	
005 - Paradangani kaburi. 12. Upi Rebus 125 Alaori 006 - Mudah diseang penya 15. Daging Panggang. 195 Nakri 007 - Tuka yang sulit sembah 5. Daging Panggang. 195 Nakri 007 - Luka yang sulit sembah 6. Iran Mas Pepes 143 Nabri 009 - Metalahan terus-menen 9. Sop Sap 27 Alari 009 - Metalahan terus-menen 9. Sop Sap 27 Alari 009 - Metalahan terus-menen 9. Sop Sap 27 Alari 010 - Marasa sangat lelahan 11. Sofdig 38 Alabri 11. Sabri Sagang 18 Kalori 13 Kalori 12. Beng Bayam 19 Kalori 14 Kalori 13. Beng Bayam 19 Kalori 14 Kalori 14. Tumis Buncit 12 Kalori 13 Kalori 15. Sayar Alaman 19 Kalori 14 Kalori 16. Jayukat 13 Kalori 15 Kalori 17. Tumis Buncits 15 Kalori 15 Kalori 16. Algukat 85 K		G04 - Penuruhan berat badan	2.	Talas Rebus		98 Kalori	
006 - Mudah disenang penya 4. Kentang Rebus 166 Kalori 006 - Mudah disenang penya 150 Kalori 0. 0. 0. 0.0 <td></td> <td>G05 - Pandangan kabur.</td> <td>3.</td> <td>Ubi Rebus</td> <td></td> <td>125 Kalori</td>		G05 - Pandangan kabur.	3.	Ubi Rebus		125 Kalori	
5. Daging Panggang 150 Kalori 6.07 Luka yang sulis tembhé Ikan Mas Pepes 143 Kalori 6.06 Merasa kaku atsu kese Ikan Mas Pepes 143 Kalori 6.06 Merasa kaku atsu kese Ikan Mas Pepes 143 Kalori 6.07 Merasa kaku atsu kese Ikan Mas Pepes 144 Kalori 6.09 Kelahan terus-menené 9. Sep Sapi 227 Kalori 6.01 Merasa sangat telah 10. Sudvir 12 Kalori 6.01 Merasa sangat telah 10. Sudvir 13 Kalori 6.01 Alarisa 28 Jakori 12 Kalori 12 Kalori 6.01 Sagun Asam 64 Kalori 14 Kalori 14 Kalori 6.01 Sagun Asam 64 Kalori 12 Kalori 12 Kalori 6.01 Sagun Marcia 52 Kalori 12 Kalori 13 Kalori 6.01 Kalori 13 Kalori 13 Kalori 15 Kalori 6.01 Kalori 15 Kalori 15 Kalori 15 Kalori 6.01		G06 - Mudah diserang penyal	4.	Kentang Rebus		166 Kalori	
60 ¹ - Lika yang sukt sembul 6. Ban Mas Pepes 143 Kalori 600 ¹ - Lika yang sukt semp. 141 Kalori 7 Kalori 600 ² - Kalekahan terus-mener 8. Ayam Panggang 164 Kalori 600 ² - Kalekahan terus-mener 8. Sop Sapi 227 Kalori 610 ² - Merasa kangat Irahan 10. Sep Sapi 227 Kalori 610 ³ - Merasa kangat Irahan 10. Segur Asam 88 Kalori 611 - Gatad i sektara Irahamini 10. Segur Asam 88 Kalori 613 - Castaj di sektara Irahamini 12. Bering Bayam 16 Kalori 613 - Nyeri atau mati rasa pai 15. Tumis Dunci Singleng 151 Kalori 16. Algukat 85 Kalori 16. Algukat 85 Kalori 16. Algukat 85 Kalori 126 Kalori 126 Kalori 126 Kalori			5.	Daging Panggang		150 Kalori	
008 - Meras kaku atau kase 7. Teur Ayum Rebus 07 Zalori 008 - Meras kaku atau kase 8. Ayam Panganga 144 Kalori 009 - Melahan tens-menen 9. Sop Sapi 227 Kalori 010 - Merasa sangat lelah 10. Suydr Azam 88 Kalori 011 - Gatal di sektor kelomini 11. Gudeg 132 Kalori 012 - Sariavan berulang kalu 13. Sayur Lodeh 61 Kalori 013 - Nyeri atau mati rasa pa 15. Tumis Dauci Singkong 151 Kalori 16. Algukat 85 Kalori 52 Kalori 16. Algukat 85 Kalori 151 Kalori		G07 - Luka yang sulit sembuh	6.	Ikan Mas Pepes		143 Kalori	
609 - Kalelahan terus-mener 8. Ayam Panggang 104 Kalori 610 - Merasa sangat kilah. 10. Segr Sapi 227 Kalori 610 - Merasa sangat kilah. 10. Segr Aapi 28 Kalori 611 - Gatad di selutar kelamini 6. Gudeg 132 Kalori 611 - Gatad di selutar kelamini 6. Gudeg 132 Kalori 612 - Sariwana beulang kalin. 12. Bernj Bayam 16 Kalori 613 - Nyeri atau mati rasa pai 15. Tumis Dunci Singleng 151 Kalori 614 data terterbih dahulu Untukt. 16. Algukat 65 Kalori 16. Algukat 65 Kalori 12.		G08 - Merasa kaku atau keser	7.	Telur Ayam Rebus		97 Kalori	
0.00° - Mercas anar tertis-interité 9. Sop Sapi 227 Kalori 0.00° - Mercas anar tellati 10. Soyur Azam 88 Kalori 0.01° - Mercas anart tellati 11. Gudeg 132 Kalori 0.01° - Castal di sektar kalami 12. Berig Bayam 18 Kalori 0.01° - Castal di sektar kalami 13. Suyur Lodeh 61 Halori 13. Suyur Lodeh 61 Halori 61 Kalori 14. Tumis Daux Singkong 151 Kalori 15. 15. Tumis Daus Singkong 151 Kalori 16. 16. Algudat 85 Kalori 126 Kalori 15. Parag Raja 126 Kalori 126 Kalori			8.	Ayam Panggang		164 Kalori	
010 - Merces sangat Ielah 10. Sayur Asam 08 Kalori 011 - Gatal di saktar Ielamini Ti. Gudeg 132 Kalori 012 - Sativani beulang Isali. 12. Bernj Bayam 16 Kalori 013 - Sativani beulang Isali. 13. Sayur Lodeh 61 Kalori 013 - Nyeri atau mati rase pai 15. Tumis Buncis 52 Kalori 013 - Nyeri atau mati rase pai 15. Tumis Dunci Singleng 151 Kalori 16. Algulat 05 Kalori 16. Algulat 05 Kalori 16. Algulat 05 Kalori 126 Kalori 126 Kalori 126 Kalori <td></td> <td>GU9 - Kelelanan terus-meneru</td> <td>9.</td> <td>Sop Sapi</td> <td></td> <td>227 Kalori</td>		GU9 - Kelelanan terus-meneru	9.	Sop Sapi		227 Kalori	
G11 - Gatal di sektar kelamin 11. Gudeg 132. Kalori G12 - Sariavan berulang kalu 13. Sayur Lodeh 61 Alori G12 - Sariavan berulang kalu 13. Sayur Lodeh 61 Alori G13 - Njeri atau mati rasa par 15. Tumis Daun Singkong 151 Kalori 16. Alputat 65 Kalori 15. 7 Lomis Jaun Singkong 126 Kalori 17. Parang Raja 126 Kalori 126 Kalori 126 Kalori		G10 - Merasa sangat lelah.	10.	Sayur Asam		88 Kalori	
01 - Sativani beulan galati 12. Bernji Bayam 16 Kalori 01 - Sativani beulang galati 13. Bayari Lodeh 61 Kalori 01 - Nyeri atau mati rasa pai 15. Tumis Duncis 52 Kalori 01 - Nyeri atau mati rasa pai 15. Tumis Duncis 52 Kalori 16. Algulat 85 Kalori 85 Kalori 16. Algulat 85 Kalori 126 Kalori		G11. Catal di sabitas balancia	11.	Gudeg		132 Kalori	
G12 - Saviavan berulang kalu 13. Sayur Lodeh 61 Kalori II.4. Tumis Buncis 32 Kalori G13 - Njeri atsu meti rasa per 15. Tumis Daur Singkong 151 Kalori II.6. Alpukat 65 Kalori IS data terlebih dahulu Untuk 17. Pirang Raja 126 Kalori		G GTT - Gatal di sekitar kelamin	12.	Benig Bayam		18 Kalori	
013 - Nyeri atau mali ranz pai 15. Tumis Buncis 22 Alari 11. Tumis Buncis 15. Salori 11. Tumis Dava Singleng 15. Salori 16. Algulat 05 Kalori 15. 15. Jagita 126 Kalori 126 Kalori		 G12 - Sariawan berulang kali. 	13.	Sayur Lodeh		61 Kalori	
15. Tumb Daux Singkong 151 Kalori 16. Alpukat 85 Kalori 17. Pisang Raja 126 Kalori		G13 - Nveri stau mati rara pa	14.	Tumis Buncis		52 Kalori	
Isi data terlebih dahulu Untuk t		C Cro Hyen atau mati rasa pa	15.	Tumis Daun Singkong		151 Kalori	
Isi data terlebih dahulu Untuk IT. Pisang Raja 126 Kalori			16.	Alpukat		85 Kalori	
		lsi data terlebih dabulu Untuk	17.	Pisang Raja		126 Kalori	
		jenis kelamin :					

Figure 11. Detection Results Display

4. CONCLUSION

This research aims to optimize the diet management of Diabetes Mellitus (DM) sufferers through food mapping using the Fuzzy Sugeno method. Based on the research results, several important conclusions were obtained:

- 1. Diet Management Optimization: The application of the Fuzzy Sugeno method in food mapping can improve the optimization of diet management for DM sufferers. The model developed can provide diet recommendations that are more personalized and in accordance with individual health characteristics.
- 2. Personalized Diet Recommendations: This method allows personalization of dietary recommendations based on the variability of health conditions, food preferences, and body responses of DM sufferers. This can help improve patient compliance with their diet plan.

- 3. Improved Blood Sugar Management: The Fuzzy Sugeno-based food mapping system has proven effective in reducing fluctuations in blood sugar levels. More precise dietary recommendations can help control blood sugar more effectively, reducing the risk of long-term complications.
- 4. Flexibility and Adaptability: The Fuzzy Sugeno method provides flexibility and adaptability to changes in patient health needs over time. This provides the basis for the development of dynamic and adaptive dietary management systems.
- 5. Contribution to Quality of Life: By providing a more effective solution for diet management, this research is expected to make a positive contribution to the quality of life of DM sufferers. Reducing cognitive load in diet management can create a positive impact on aspects of daily life.

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