



Expert System to Diagnose Periodontics Disease (Gum Disease) Using K-Nearest Neighbour Algorithms

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ABSTRACT

A Technological Growth has occurred rapidly at this time. not only in the fields of information, industrial or education but also in the agricultural fields. Therefore the sophistication of the technology was also utilized in order to getting an information about Periodontics (gum disease). Periodontics caused by poor oral hygiene condition. in this problem, a technique that used to diagnose Periodontics disease to be able to helping the doctors and citizens about the disease is really necessary. Therefore the author will design and developing a desktop-based application expert system to diagnose Periodontics disease using K-Nearest Neighbor method. Systems will analyze someone based on the previous data of the patients. as a user, patients will insert a data based to their symptoms in order to generate not only an identification of the probabilities accuracy data but also the solution about this disease. this expert system was developed with K-Nearest Neighbor methods for measuring a certainty value from the new hypothesis of new facts based on the previous consultation data records of the patient. the calculation of K-Nearest Neighbor methods has been generated 0.72 or 72% of trust value from one Periodontics disease based on the result of consultation.

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1. Introduction

Mouth is a very important human sense organs of humans. As well as the other sensory organs, mouth has a very important function, namely as a sense of taste. Due to the importance of the oral function, it is always obligatory to protect the mouth to avoid oral diseases. to keep the mouth healthy, many people even are willing to spend a lot of money on oral care. There are several diseases that occur in the mouth, one of which is Periodonticist (Gum Disease). Periodonticists (Gum Disease) are caused by poor oral hygiene. in this case a technique that used to diagnose Periodontics disease to be able to helping the doctors and citizens about this disease is really necessary. In addition to examination techniques to the doctor, there are several techniques that can be used to diagnose Periodonticist disease (gum disease), including the Expert System.

Expert System is one of the artificial intelligence fields which is a system designed to imitate the skills of an expert in solving a problem. One of the approaching expert system methods is the K-Nearest Neighbor algorithm which has the characteristic of an approach to search for cases by calculating the closeness of the new case to the old case. In solving the problem, the K-Nearest Neighbor calculation will be used. In the calculation of K-Nearest Neighbor there is the term "Similarity", namely equations.

K-Nearest Neighbor is a basic concept of geometry in mathematics which expresses the similarity of two objects. Two objects are said to be similar if they have the same shape. In other words, there is no significant difference between the two objects in a geometric manner.

2. Theoretical Basis

Expert system is a system designed to be able to imitate the expertise of an expert in answering questions and solving a problem so that it can solve problems and make decisions that are usually done like an expert [1].

Expert systems are computer-based systems that use knowledge, facts and reasoning techniques in solving problems that usually only an expert in the field can solve [2].



3. Research Methodology

Research methodology is a scientific step that is used to collect theories and matters relating to the research being carried out and the process undertaken to complete the research. The following are some of the research methods used, namely: Pengumpulan Data

- 1) Observation
- 2) Interview
- A. Library Research
- B. Data Analyzation
- C. System Design
- D. System Implementation
- E. Testing

3.1 K-Nearest Neighbour Methods

K-Nearest Neighbor is an algorithm for classifying objects based on learning data that is closest to the object. The K-Nearest Neighbor algorithm classifies new data whose class is unknown by selecting the number of k data that is closest to the new data. The class with the most number of data closest to the number of k will be selected as the class that is predicted for the new data. In general, the value of k uses an odd number so that there are not the same distances in the classification process. Far or near neighbors were calculated using the Euclidean distance[3].

KNN is included in the instance-based learning group which aims to classify a new object based on attributes and KNN training is used in application problems, one of which is for classification problems and as a learning and training function..

3.2 Steps of K-Nearest Neighbor Methods

The steps of the K-Nearest Neighbor method are::

- A. Identification of disease data and symptoms data
- B. Symptoms weight value Assignment
- C. Determine new cases data
- D. Determine Similarity values from each attribute
- E. Determine Similarity values from new and old cases

$$Similarity(T, S) = \frac{\sum_{i=1}^n f(T_i, S_i) \times W_i}{W_i} \quad (1)$$

Description:

- T : New Cases
 S : Case in the storage of the systems
 n : attribute number from each cases
 i : Individual cases beetwen 1 to n
 f : Similarity function attribute of i beetwen T and S cases
 W : Weight beetwen attribute of i

- F. Recapitulation of similarity values

3.3 Data Analyzing

The Periodontics disease data and symptoms data are:

Table 1
Periodontics patient data

No	Name	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	Diagnose
1	Mela	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Chronic Periodontics
2	Dwi	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Periodontics
3	Dani	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Periodontics
4	Anggi	No	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Chronic Periodontics
5	Caca	No	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Periodontics
6	Fani	Yes	No	No	Yes	No	Yes	Yes	No	Yes	Yes	Periodontics
7	Mina	Yes	Yes	Yes	No	Yes	No	Yes	Yes	No	Yes	Chronic Periodontics
8	Tono	No	No	Yes	No	Yes	Yes	No	Yes	Yes	No	Periodontics



No	Name	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	Diagnose
9	Angle	Yes	Yes	No	No	No	No	No	No	No	No	Periodontics
10	Hilal	Yes	No	No	No	No	Yes	No	No	Yes	No	Not Periodontics

4. Result and Implementation

4.1 K-Nearest Neighbor Methods process

A. Identification of disease and symptoms data

Table2
Disease and Symptoms data

No	Disease name	Symptoms
1	Periodontics Disease	<ul style="list-style-type: none"> - Swelling of the gums - Gums are bright red or purplish - Gums that are painful to the touch - Gums are reduced in height, making the teeth look longer than usual - Cavities form between the teeth - Pus between the teeth and gums - Smelly breath - No good taste in the mouth - Loose teeth - Changes in teeth when biting.

B. Symptoms value assignment

Table 3
Periodontics disease weight value symptoms data

No	symptoms	Weight value
1	Swelling of the gums	70
2	Gums are bright red or purplish	80
3	Gums that are painful to the touch	75
4	Gums are reduced in height, making the teeth look longer than usual	80
5	Cavities form between the teeth	75
6	Pus between the teeth and gums	85
7	Smelly breath	60
8	No good taste in the mouth	60
9	Loose teeth	60
10	Changes in teeth when biting	70

Table4
Periodontics disease weight value normalization

No	Symptoms	Weight value	Norm.
1	Swelling of the gums	70/715	0.10
2	Gums are bright red or purplish	80/715	0.11
3	Gums that are painful to the touch	75/715	0.10
4	Gums are reduced in height, making the teeth look longer than usual	80/715	0.11
5	Cavities form between the teeth	75/715	0.10
6	Pus between the teeth and gums	85/715	0.12
7	Smelly breath	60/715	0.08
8	No good taste in the mouth	60/715	0.08
9	Loose teeth	60/715	0.08
10	Changes in teeth when biting	70/715	0.10

C. Determine new case data

Table5
New Patients data

No	Name	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10	Diagnose
1	Rustam	Yes	No	Yes	No	Yes	No	Yes	Yes	Yes	No	???



D. Similarity values of each attribute determination

Table6
SimilarityValue Atribut

Value 1	Value 2	Similarity
Yes	Yes	1
No	No	1
Yes	No	0.1
No	Yes	0.1

E. Calculation of similarity values beetwen new and old case

Calculation of new cases similarity value (Rustam) and case Number.1 (Mela)

Table7
New Case similarity value with new cases

Name	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10
Rustam	Yes	No	Yes	No	Yes	No	Yes	Yes	Yes	No
Mela	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Similarity	1	0.1	1	1	1	0.1	1	1	1	0.1
Attribute	a	b	c	d	e	f	g	h	i	j

Table8
Weight values case 1

Attribute	Weight values	Attribute Values
K1	0.10	W1
K2	0.11	W2
K3	0.10	W3
K4	0.11	W4
K5	0.10	W5
K6	0.12	W6
K7	0.08	W7
K8	0.08	W8
K9	0.08	W9
K10	0.10	W10

$$\text{Distance} = \frac{[(a*w1)+(b*w2)+(c*w3)+(d*w4)+(e*w5)+(f*w6)+(g*w7)+(h*w8)+(i*w9)+(j*w10)]}{w1+w2+w3+w4+w5+w6+w7+w8+w9+w10}$$

$$\text{Distance} = \frac{[(1*0.10)+(0.1*0.11)+(1*0.10)+(1*0.11)+(1*0.10)+(0.1*0.12)+(1*0.08)+(1*0.08)+(1*0.08)+(0.1*0.10)]}{0.10+0.11+0.10+0.11+0.10+0.12+0.08+0.08+0.08+0.10}$$

$$\text{Distance} = \frac{0.68}{1}$$

$$\text{Distance} = 0.68$$

Calculation of new cases similarity value (Rustam) and case Number.2 (Dwi)

Table9
Case Similarity with case no.2

Name	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10
Rustam	Yes	No	Yes	No	Yes	No	Yes	Yes	Yes	No
Dwi	Yes	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Similarity	1	1	1	0.1	0.1	0.1	1	0.1	1	0.1
Attribut	a	b	c	d	e	f	g	h	i	j

$$\text{Distance} = \frac{[(a*w1)+(b*w2)+(c*w3)+(d*w4)+(e*w5)+(f*w6)+(g*w7)+(h*w8)+(i*w9)+(j*w10)]}{w1+w2+w3+w4+w5+w6+w7+w8+w9+w10}$$

$$\text{Distance} = \frac{[(a*w1)+(b*w2)+(c*w3)+(d*w4)+(e*w5)+(f*w6)+(g*w7)+(h*w8)+(i*w9)+(j*w10)]}{w1+w2+w3+w4+w5+w6+w7+w8+w9+w10}$$

$$\text{Distance} = \frac{[(1*0.10)+(1*0.11)+(1*0.10)+(1*0.11)+(0.1*0.10)+(0.1*0.12)+(1*0.08)+(0.1*0.08)+(1*0.08)+(0.1*0.10)]}{0.10+0.11+0.10+0.11+0.10+0.12+0.08+0.08+0.08+0.10} \text{Distance} = \frac{0.52}{1}$$

$$\text{Distance} = 0.52$$



Calculating Similarity Value of New Case (Rustam) and Case No.3 (Dani)

Table 10
Case Similarity with case no.3

Name	K1	K2	K3	K4	K5	K6	K7	K8	K9	K10
Rustam	Yes	No	Yes	No	Yes	No	Yes	Yes	Yes	No
Dani	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Similarity	1	0.1	1	0.1	1	0.1	1	1	1	0.1
Attribut	a	b	c	d	e	f	g	h	i	j

$$Distance = \frac{[(a*w1)+(b*w2)+(c*w3)+(d*w4)+(e*w5)+(f*w6)+(g*w7)+(h*w8)+(i*w9)+(j*w10)]}{w1+w2+w3+w4+w5+w6+w7+w8+w9+w10}$$

$$Distance = \frac{[(1*0.10)+(0.1*0.11)+(1*0.10)+(0.1*0.11)+(1*0.10)+(0.1*0.12)+(1*0.08)+(1*0.08)+(1*0.08)+(0.1*0.10)]}{0.10+0.11+0.10+0.11+0.10+0.12+0.08+0.08+0.08+0.10}$$

$$Distance = \frac{0.58}{1}$$

$$Distance = 0.58$$

The process of calculating the value of the similarity of new cases based on old cases is carried out on all data in the database in the system so that all old patient data get a similarity value or distance value.

F. Recapitulate Similarity Values

From the calculations above , it can be seen the value of the similarity, here is a recapitulation of the value of closeness between cases.

Table 11
Recapitulate Similarity Value

Patient No	Patient Name	Similarity Value
1	Kasus 1 (Mela)	0.68
2	Kasus 2 (Dwi)	0.52
3	Kasus 3 (Dani)	0.58
4	Kasus 4 (Anggi)	0.35
5	Kasus 5 (Caca)	0.43
6	Kasus 6 (Fani)	0.43
7	Kasus 7 (Mina)	0.72
8	Kasus 8 (Tono)	0.71
9	Kasus 9 (Angel)	0.49
19	Kasus 10 (Hilal)	0.55

Based on the table above, the highest value of closeness between the old case and the new case is the closeness value to case 7, namely Mina. So, for new patient data on behalf of "Rustam" diagnosed with the disease "Chronic Periodontic Exposure" by producing a weight of similarity, namely "0.72".

4.2 Implementation

In order to realize a system that has been designed in an information system, other supporting facilities are needed in principle, commonly referred to as technical aspects, namely:

- A. Hardware
- B. Software
- C. Brainware
 - 1) Login Menu

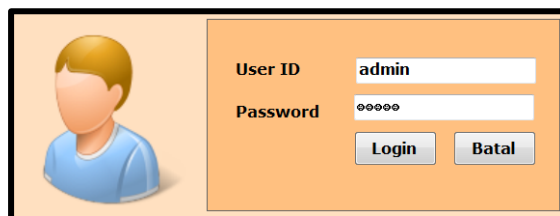


Fig 1. Login Menu



2) Main Menu



Fig 2. Main Menu

3) Old Cases data menu

Diagnosa Gejala

- Pembengkakan gusi Tidak
- Gusi berwarna merah terang atau keunguan Tidak
- Gusi yang terasa nyeri saat disentuh Tidak
- gigi terlihat lebih panjang dari biasanya Tidak
- Rongga terbentuk di antara gigi Tidak
- Nanah di antara gigi dan gusi Tidak
- Napas berbau Tidak
- Rasa tidak sedap pada mulut Tidak
- Gigi lepas Tidak
- Perubahan pada gigi saat menggigit Tidak

Na...	G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	Diagnosa
Mala	Ya	Ya	Ya	Tidak	Ya	Ya	Ya	Ya	Ya	Ya	Periodontis Kronis
Dani	Ya	Ya	Ya	Ya	Ya	Ya	Ya	Ya	Ya	Ya	Periodontis
Anggi	Tidak	Ya	Ya	Ya	Ya	Ya	Ya	Tidak	Tidak	Ya	Periodontis Kronis
Caca	Tidak	Tidak	Ya	Ya	Tidak	Ya	Ya	Tidak	Ya	Ya	Periodontis
Fani	Ya	Tidak	Tidak	Ya	Tidak	Ya	Ya	Tidak	Ya	Ya	Periodontis
Mina	Ya	Ya	Ya	Tidak	Ya	Tidak	Ya	Ya	Tidak	Ya	Periodontis Kronis
Tono	Tidak	Tidak	Ya	Tidak	Ya	Ya	Tidak	Ya	Ya	Tidak	Periodontis
Angle	Ya	Ya	Tidak	Tidak	Tidak	Tidak	Tidak	Tidak	Tidak	Tidak	Periodontis
Hilal	Ya	Tidak	Tidak	Tidak	Ya	Tidak	Tidak	Ya	Ya	Tidak	bukan Periodontis
Dwi	Ya	Tidak	Ya	Ya	Tidak	Ya	Ya	Tidak	Ya	Ya	Periodontis

Fig 3. Old Cases data menu

4) Disease data menu

Kode: K02

Nama Penyakit: Periodontis

Solusi: Scaling untuk menghilangkan tartar dan bakteri dari permukaan gigi dan dibalik gusi, Root planing untuk menghaluskan permukaan akar saraf dengan tujuan mengurangi dan menghilangkan bakteri dan hal-hal lain

Ko...	Nama Penya...	Solusi
K01	Periodontis K...	Gosoklah gigi tiap selesai ma...
K02	Periodontis	Scaling untuk menghilangkan ...

Fig 4. Disease data menu

5) Symptoms data and symptoms weight value

The screenshot shows a software window titled "frmbobot" with the following fields and a table:

- Kode: B10
- Nama Gejala: Gigi lepas
- Nilai Bobot: 60
- Simpan button
- Table of symptoms and weights:

Ko...	Nama Gejala	Bobot...
B01	Pembengkakan gusi	70
B03	Gusi berwarna merah terang atau keunguan	80
B04	Gusi yang terasa nyeri saat disentuh	75
B05	Gusi yang berkurang ketinggiannya sehingga, memb...	80
B06	Rongga terbentuk di antara gigi	75
B07	Nanah di antara gigi dan gusi	85
B08	Napas berbau	60
B09	Rasa tidak sedap pada mulut	60
B10	Gigi lepas	60
B02	Perubahan pada gigi saat menggigit	70

Keluar button

Fig 5. Symptoms data and symptoms weight value

The screenshot shows a software window titled "Form Konsultasi" with the following fields and a checklist:

- Kode Pasien: K01
- Alanat: Jalan Danau Singkarak No. 224 Medan
- Nama Pasien: Rustam
- No. Telp: 085277752383
- Diagnosa Gejala section with a list of symptoms and dropdown menus:

Diagnosa Gejala	Ya / Tidak
Pembengkakan gusi	Ya
Gusi berwarna merah terang atau keunguan	Tidak
Gusi yang terasa nyeri saat disentuh	Ya
gigi terlihat lebih panjang dari biasanya	Tidak
Rongga terbentuk di antara gigi	Ya
Nanah di antara gigi dan gusi	Tidak
Napas berbau	Ya
Rasa tidak sedap pada mulut	Ya
Gigi lepas	Ya
Perubahan pada gigi saat menggigit.	Tidak

Nilai Keyakinan: 0.74

Jenis Penyakit: Periodontis Kronis

Proses button

Lihat Hasil button

Fig 6. Consultation Menu

De Dentisc Clinic
J City Jalan Karya Wisata Telp: 082388283902

Laporan Hasil Konsultasi Pasien

Nama Pasien : Rustam
Alamat : Jl. Brijien Katamso Gang Madrasah No. 234
No. Telp : 082245456578
Jenis Penyakit : Periodontis Kronis
Tingkat Keahlian : 0.74

Solusi
Gosoklah gigi tiap selesai makan atau paling tidak 2 kali sehari, yaitu di waktu pagi dan malam hari menjelang tidur. Gunakan sikat gigi yang lembut, dan ganti sikat gigi setelah dipakai selama 3-4 bulan. Jangan lupa untuk membersihkan sela-sela gigi menggunakan benang gigi. Selain rajin menyikat gigi, rutinitas memencasakan gigi dokter gigi tiap 6 bulan sekali.

Medan, 22-July-2019
Diketahui Oleh:
(Drg. Eka Andayani)

Fig 7. Consultation Report

5. Conclusion

Based on the results of this study, the conclusion are:

- The application of the K-Nearest Neighbor algorithm to diagnose Periodonticst disease is by giving a values for each symptom between 0-100 for each symptom.
- The application design uses UML, while the application display uses a visual programming language, the Access database is a place to store case data and consultation data.
- Testing the system by implementing the calculation data in chapter 3 and the calculation results of the system processed by the K-Nearest Neighbor Algorithm until the system produces the same calculations as manual data testing

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