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FACE SKIN DISEASE RECOGNATION USING FUZZY SUBTRACTIVE CLUSTERING ALGORITHM

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ABSTRACT

Face skin is the most sensitive part of the body compared to other parts of the body and therefore need special attention. Face skin problems such as acne, comedo or wrinkles causes people to be insecure as well as a health hazard if it is not treated. This research is related to face skin disease, such as acne, blackheads or comedo, skin infection etc. In general, those diseases can become dangerous if it is not handled immediately. This research will facilitate user to determine the recommended treatments for this skin disease based on the symptoms, and the recommended medicines to treat the disease. The research include the analysis method through surveys, including interviews with several specialists who specializes in skin treatments and diseases. The data processing of patients' is using fuzzy subtractive clustering algorithm to provide recommendation of treatments for the skin disease. After clustering and a series of inputs of symptoms, this research is able to provide an introduction of skin disease at the precision close to 100 percents and able to recommend correct treatments which is mostly the same as the treatment by a dermatologist.

Keywords *Skin Disease, Skin Infection, Medicine, Fuzzy Subtractive Clustering,Skin Treatments*

1. BACKGROUND

The face skin is one of the important part of the body that needs a special attention to treat, because the face skin is one of the part that is the most sensitive compared to other parts of the body. The appearance of several problems on the skin such as freckles, comedo, or wrinkles will of course cause us to become inconfident. In this modern era, a lot of clinics specializes in skin treatment emerge, therefor it is easier to perform skin treatment specially on the face.

However, for those with limited time, the distance between home and the clinic can be far, or a there are a lot of existing patients such that it would waste time for candidate patients. From the result of the survey, there are 60% patients who have never perform a facial skin treatment. This indicates that there are no awareness to do a facial skin treatment.

Recently, the field of Medicine use of technology to help increase the customer service. In the word of computers, the correct action to identify a disease can be realized through the development of Expert System. In this case a patient needs an expert system to find out the recommended treatments and medicines for the face before actually visiting the skin treatment clinic. Because of the mentioned problem, a tool

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to help the diagnosis is required, which is an expert system based on artificial intelligence. Basically, an expert system has the capabilities to solve the problem using information and the reasoning technique is usually related to specialist or experts (changchit, 2008), so that it is expected that that the system can think and has the intelligence as humans have.

2 SCOPE OF RESEARCH

The scope of this research is as follows:

1. Focused on some of the skin diseases.
2. The skin that is analyzed does not haveany abnormality
3. The skin cannot be black or have certain abnormality from birth.
4. More focused on skin of women

3 OBJECTIVES OF RESEARCH

The objective of this research is :

1. To develop a concept an method that can provide a recommendation or identify a skin disease that a user is suffering. (face skin disease recognition). To perform the testing in this research, a mobile based android will be used. The benefits of this research is
2. To facilitate anuser to detect an early symptom from the skin disease, so that a proper handling can be performed.
3. To facilitate anuser that has difficulties to go to the clinic in order to find out the skin disease, through the symptoms experienced by the user.

4. EXPERT SYSTEM ON MEDICINE AND OTHER FIELDS

Intelligent System can solve real-world problem usng the human knowledge and a reasoning capabiity of humans. In the 21st century artificial intelligent is one of the important research topic in almost all fields: technical, science, education, medical, business, accounting, finance, marketing, economy, capital market and law. Compter is used as a tool to store the knowledge of experts. Therefore computers will have the expertise to solve problems by simulatih the expertise from experts.

Expert System is a computer software that solves problems using information and reasoning techniques usually related to human experts or experts. Usually the development of expert systems involve four main activities. The progress in computer technoology is the development of software make use of knowledge expert domain to develop a tool that is smarter and able to help medical practioners for making decisions (turban et al 2005, Changchit et al 2008). Artificial Intelligence is the study to imitate the human intelligence in computer technology and the potential has been studied by several researcher (Tsipouras et al., 2008).

The usage of an expert system can be implemented easily and efficiently using machine language using Fuzzy logic. Fuzzy logic has been an interesting research area because of the ability to bridge machine language which is very precise and accurate with a language used by humans that tends to be not quite precise and stressed on the meaning (Significance). The evaluation of the research proposed expert system which was achieved with the import of certain medical cases and the system produced with suitable successful skin tests (Karagiannis et al,2006). For detection of various Skin diseases using Region of Interest Extraction using color (Singh Jaspreet,2013). Include Skin research are using Dempster-Shafer Theory for detecting skin diseases and displaying the result of detection process (Maseleno, A. and Hasan, M. M., 2012).

The term fuzzy means blur. A value can be true or false. In fuzzy, it is known that memer

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degree has a span from 0 (zero) to 1 (one), different than a fixed set that has a value of 1 or 0 (yes or no). The advantage of logic theory of fuzzy is the ability to proses reasoning as a language (linguistic reasoning), so that in the design, there is no requirement of a mathematical equation from the object of control (Kusumadewi,2004). Actually Fuzzy system is a human language translation machine so that it can be understood by machine language and vise versa (Patra, 2010; Kumar et al 2013).

Other the connectionist expert system for medical diagnosis of the most common skin disease the Scabies using Artificial Neural Network (ANN) based classifier. The system helps the medical professional in making effective treatment to patient, by reducing unnecessary cost (Sha P trupti , Shah Pooja J,2008). Even some research for skin cancer recognition by using combination of algorithm and methode such as neuro-fuzzy algorithm and others (Salah, B.et al, 2011)

5. RESEARCH METHODOLOGY

The method that will be used in this research, in order to identify and understand types of face skin diseases as well as the recommended treatment using the fuzzy algorithm of subtractive clustering. The steps to support this research is as follows (see diagram 1.0) :

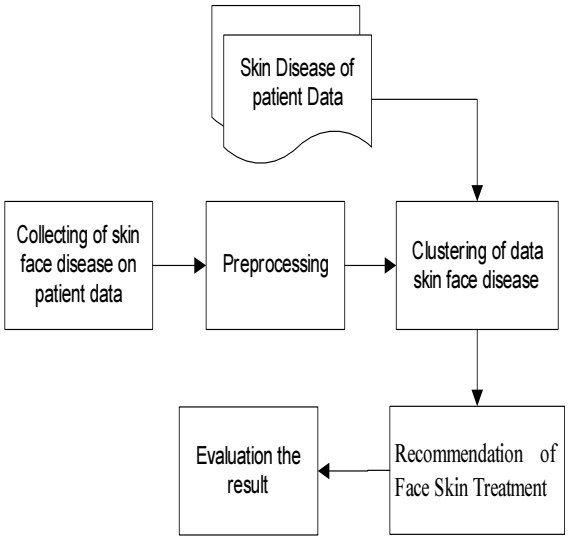

Figure 1.0 : The steps to identify types of face skin diseases of a patient

From Figure 1.0 shows the process of identifying face skin disease of a patient, including to recommend the apropriate treatment and medicins for the skin disease. In detail, the steps include of the following:

5.1 Data Collection Of Patients' Condition

Medical records contains everything abaout the history of the patient, such as physical check up, diagnosis, treatments and the coresponding result, physician's reporrts, nurse's reports, laboratiry results, radiology etc. These data are confidential, therefore cannot be released to a third party without the patient's consent, unless there are other reasons based on law that force to release the information. Therefore the author is using questionnaire which is distributed to 100 (one hundred) people at random. The data collected will be the primary data. The image of a patient is divided into 2 (two) parts, which is based on age and type of skin.

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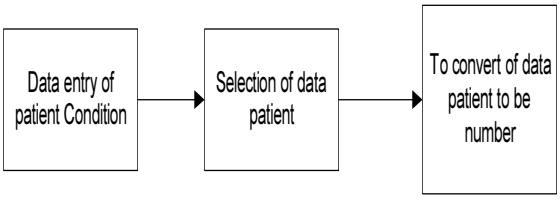
5.2 Preprocessing

The initial process consist of :

1. Selection of data Patient.
   In this step, the same data in the same field will be deleted , so that the creation of rules will not overlap.
2. To Covert of data patient to be number.
   All data in each field is converted to a number so that it can be processed for the data grouping.



5.3 Skin Face Diseased Using Subtractive Clustering

The grouping of data using the subtractive clustering is to identify areas into a variable that has high density towards the psurrounding points. A point with the highest number of neighbor will be chosen as the center of the cluster. The density of the point that is chosen to be the center will be subtracted. Then another point that has the most neighbor to represent another cluster. This step is repeated until all points has been tested.

The fuzzy subtractive clustering method is a method of unsupervised clustering where the number of central cluster is unknown. This method is using the data as a candidate of the cluster, so that the calculation burden depends on the number of data and not the data dimension. The number of cenral cluster is determined through the iterative process for finding the points that has the most neighbor. After that the ccnetral cluster is returned to the normalized form as its initial form.

If there are N data: X1, X2, ..., XN and assuming that the data is in the normal form, then the density point Xk can be calculated as (Gelley, 2000) :

$$D_k = \sum_{j=1}^{N} \exp\left(-\frac{\|X_k - X_j\|}{\left(r_j/2\right)^2} \right) \quad (3.1)$$

where ||X¬k-Xj|| is the distance between Xk dengan Xj, and r is a positive constant that is known as the radius. Radis is in the form of a vector that will determine how large the effect of central cluster to each variable. Therefore, a data point can have a high density if it has a large number of neighbors. By calculating the density of each points, the points with the highest density will be chosen as the center cluster. For example, if XC1 is a poit chosen as the center cluster, and DC1 is the size fo the density, then the density from the neighboring points is subtracted to become (Gelley, 2000)

where rb as the positive contrant. This means that the points that is near the center cluster will be subtracted by the density. This will cause the points to be difficult to be the next center cluster. The value of r¬b shows that an environment that causes the point the decrease the size of the density. Usually rb is greater than r, rb=q*ra (where q is the squash factor which is used to control th radius and ra is the previous value or rb). After all the density of each points is corrected, then the next step is to find the second center cluster. After it is obtained, the size of the density on each point will be fixed again, and so on. At the implementation, 2 fractions are used as a comparison factor, which is accept ratio and reject ratio. Accept ratio and reject ratio, both is a fractional number between 0 and 1. Accept ratio is the lower limit where a data point is a candidate center cluster and allowed to become a center cluster, whereas reject ratio is the upper limit merupakan batas where it represents a

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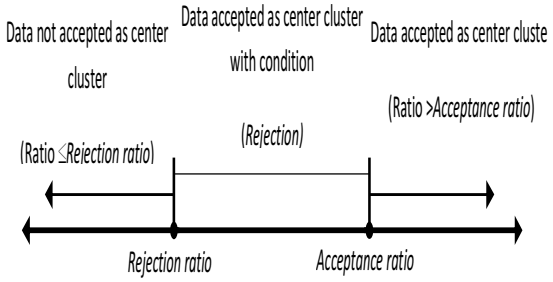
candidate center cluster but not allowed to become a center cluster.

There are 3 conditios that can occur in an iteration :

1.If Ratio >Accept ratio, then the data point is accepted as a new center cluster.

2.If Reject ratio < Ratio ≤ Accept ratio, then the data point can be accepted as a new center cluster if the data point is located at a far from the other cluster. (the sum of ratiom and the nearest distance from other cluster >= 1). If the sum of ratio and the longest distance from the center cluster < 1, then beside the data point, it will not be allowed to become a center cluster and will not be considered to become the new center cluster (the potensial is set to zero).

3. If the Ratio ≤ Rejection ratio, then there are no more points that can be considered to become candidate center cluster, then the iteration stops.



For the Fuzzy Subtractive Clustering algorithm, the steps are as follows:

1. Input data that will be clustered: Xij, where i = 1,2,...,n; dan j = 1,2,...,m.
2. Identification of rj, accept ratio, reject ratio, xmin (minimum data), and xmaks (maximum data), with j = 1,2,...,m.
3. Normalization

$$X_{ij} = \frac{X_{ij} - XMin_j}{XMax_j - XMin_j}, \qquad i = 1,2,\dots,n; \;\; j = 1,2,\dots,$$

Where n si the number of data, m is the number of attributes, XMinj and XMaxj is the minimum dan maximum data that are allowed to become the input.

4. Determine the inital potential of each data using the equation (3.1).
5. Searching for data with the largest potetial value which is Pc1 (initial potential that is chosen to become the first center cluster).
6. Subtract the potential data around the first center cluster using equation (3.2).
7. Search for data with highest potetial for second iteration and so on.
8. Identity the center cluster (data with the highest potential to become a center cluster).
9. Return the center cluster from mormalized form to the initial form :

Centerij =Centerij*(XMaxj-XMinj)+Xminj

$$\sigma_j = r_j * \frac{XMax_j - XMin_j}{\sqrt{8}}$$

10. Calculate the sigma cluster

The result of applying Substractive clustering algorithm ia a center cluster matrix (C) and sigma (Ω) that will be used to identify the parameter value for the Gauss member function. With the Gauss curve, then degree of the membership of a poit Xi on the kth cluster, is:

$$\mu_{ki} = e^{-\sum_{j=1}^{m} \frac{(X_{ij} - C_{kj})^2}{2\sigma_j^2}}$$

$$i = 1,2,\dots,l; \;\; j = 1,2,\dots,n$$

Where l is the number of data, n is the number of attributes, m is the number of cluster column, X is the data, C is the cluster, and σ is sigma.

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5.4 Recommendation Of Face Skin Treatment

In order to receive recommendation of face skin treatment, where one of the method is to obtain the member degree in a fuzzy set using fuzzy clustering. After the variables are deivided into fuzzy sets, then fuzzy inference system can be built. For example if there are n data where eavh data has p variables (attribute), then the data can be organized to become X matrix of size nxp. Using fuzzy substractive clustering algorithm with : radius (r), acceptance ratio, rejection ratio, and squash factor, the center cluster C and sigma ca be obtained. To form FIS from the result of the clustering, the Sugeno of the first order in fuzzy inference method is used. Previously, the existing data is separated to input and output variables. For example, if the number of input variable is m, and output variale is usually 1. Using this method, a set of rules are created as follows (Kusumadewi et al, 2004) :

[R1] IF (x1 is A11)o(x2 is A12)o...o(xn is A1m) THEN (z=k11x1+...+k1mxm+k10);

[R2]IF (x1 is A21)o(x2 is A22)o...o(xn is A2m) THEN (z=k21x1+...+k2mxm+k20);

where :

- ✓ Aij is the ith fuzzy set and the jth variable as the antocedent,
- ✓ Kij is the coefficient of equation of output fuzzy ith rule and jth variable (i=1,2,...,r; j=1,2,...,m), and ki0 is the constant in output fuzzy equation ith rule;
- ✓ The symbol o shows the operator that is used in the antecedent.
- ✓ The number of rules created = r, equal to the number of created cluster. For example, after performing clustering, 5 center cluster, and later in the Fuzzy Inference Sistem will also have 5 new rules.

As an example, if the number of cluster is 5 on a radius 0.5 in the frst output, (recommended for treatment). The rules formed is as follows (Kusumadewi et al, 2004) :

[R1] : If (Age Is Age1) And (Skin type Is Jskin1) And (Perawatansebelumnya Is Prwtsblm1) And (Complaint Is Complaint1) And (Allergy Is Allergy1) Then Treatmentrecommendations = Z1.

where Z1 = K11x1+ K12x2 + K13x3 + K14x4 + K15x5 + K10

[R2] : If (Age Is Age2) And (Skin type Is Jskin2) And (Perawatansebelumnya Is Prwtsblm2) And (Complaint Is Complaint2) And (Allergy Is Allergy2) Then Treatmentrecommendations = Z2.

where Z2 = K21x1+ K22x2 + K23x3 + K24x4 + K25x5 + K20

[R3] : If (Age Is Age3) And (Skin type Is Jskin3) And (Perawatansebelumnya Is Prwtsblm3) And (Complaint Is Complaint3) And (Allergy Is Allergy3) Then Treatmentrecommendations = Z3.

Where Z3 = K31x1+ K32x2 + K33x3 + K34x4 + K35x5 + K30

[R4] : If (Age Is Age4) And (Skin type Is Jskin4) And (Perawatansebelumnya Is Prwtsblm4) And (Complaint Is Complaint4) And (Allergy Is Allergy4) Then Treatmentrecommendations = Z4.

where Z4 = K41x1+ K42x2 + K43x3 + K44x4 + K45x5 + K40

[R5] : If (Age Is Age5) And (Skin type Is Jskin5) And (Perawatansebelumnya Is Prwtsblm5) And (Complaint Is Complaint5) And (Allergy Is Allergy5) Then Treatmentrecommendations = Z5.

Formation of antecedents (IF parts) on this system using the product (prod) as an antecedent operator that will be used to find the fire strength

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(α-predicate) on every rule. While on the consequent (THEN part) is a linear equation z = U * k. With U as the universal matrix, k as coefficients, and z as the output vector. After that process defuzzy using weighted average method.With the rules based on age, skin type, previous treatment, complaints and allergy that a patient has, the recommendation can be obtained.

5.5 Evaluatiom and Recommendation

The result of the evaluation using the structured fuzzy subtractive clustering to obtain a treatment recommendation and medication, that is related to the skin disease. So this research using this algorithm can prove the reality. Even there are so many varianble must be explored to get the result the same as the reality. But all the variable must be consulted with the expert of skin desease such skin doctor.

Evaluation of the result obtained from fuzzy subtractive clustering for the person's first output and second Ouput (Recommended Treatment and Medication) will be seen in table 1 and table 2.

Table 1 : Evaluation Table Of Ouput Recommendation And Actual Treatment

Output Treatment Recommendation (FSC)	Actual Treatment output
1.0000	1
1.0000	1
1.0000	1
1.0000	1
1.0000	1
1.0000	1
2.0000	2
3.0000	3
3.0000	3
3.0000	3
3.0000	3
4.0000	4
4.0000	4
4.0000	4
4.0000	4

5.6 Calcualtion of Recommended Treatment Error System

The smaller the error resulted from the system, the greater the acuracy will be. The experiment of decreasing the radius value that started from 1 to form FIS rule. The result of the eperiment of substractive clustering using different radius value, showed there is an squared average decrease error when the radius approached 0 (zero). On the frst using 0.6-1 radius, a average squared error is obtainedpproximately 0.1-1.1, whereas second outputusing the same radius the average squared errorobtained is around 0.4-0.9. For both output, using radius 0.1-0.6 the average squared error obtained approaced 0 or about e-13 to e-16. Thus it is decided that the experiment is sufficient using radius 0.5 on each output. Therefor it is concluded that the result of the

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research, the error is very sall and approaching 0 (zero) in order to provide recommendation of skin treatment.

Table 2 Evaluation Table Of Ouput Recommended And Actual Medication

output recommended medication	Output actual Medication
2.000	2
2.000	2
2.000	2
6.000	6
2.000	2
1.000	1
1.000	1
2.000	2
2.000	2
1.000	1
3.000	3
1.000	1
2.000	2
1.000	1
2.000	2

6 CONCLUTION AND RECOMMENDATION

6.1 CONCLUTION

Based on the implementation and evaluation, using fuzzy subtractive clustering in the sense of identifyng treatment recommendation and medication for skin disease can be concluded as follows:

1. The research on face skin disease uses supporting variable such as Age, gender, previous treatments, complaints and allergies.
2. This research need improvement to detect another skin disease by doing more supporting of variable and methode.
3. This research will result in output for recommendation of skin treatment, including further medication and treatment for the face.
4. Recommendation of skin treatment is almost the same as the recommendation given by the dermatologist.
5. Error system from this research approaches 0 (zero), thus for certain skin diseases, the result of this research is quite accurate and supportive.

6.2 RECOMENDATION

It is expected that the usage of this subtractive clustering algorithm can be extended in order to identify other face skin related diseases and able to inspire other researcher such that not only it will identify and recommend treatment to common face skin diseases but also as an early detection of face skin cancer.

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